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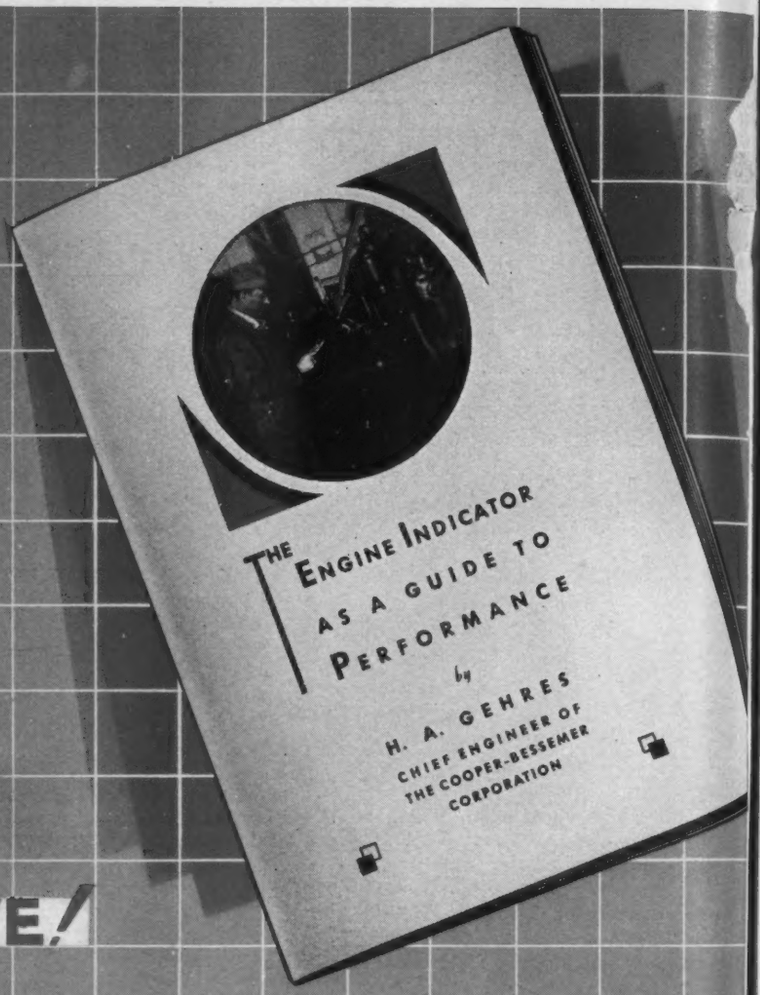

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REFINER
AND NATURAL GASOLINE MANUFACTURER

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VOLUME 10, No. 3 MARCH, 1931

Improvement Must Follow Disaster

THERE can be no sustained upturn for the petroleum industry until several impending events have become reality.

Chief among these is some definite knowledge of the amount of crude oil reserve for the United States. No accurate check of crude oil can be made until proration has either run its course or has been supplanted by the open flow of oil fields. The outstanding drawback to proration is the indefinite stamp it places on reserves. Under its workings, only estimates of reserves are possible. The total has been set as high as 15,000,000 barrels daily for the United States. While this is considered excessive, still no one can give the exact figure.

While the reserve of raw material is left in the hands of estimates and imagination, the petroleum industry must hesitate and make only false starts at recovery.

Linked directly with reserve is the price of raw material. The whole tendency right now is downward. Until prices have been put down to the lowest level, no upward move of importance is possible for the industry as a whole.

Recently small refining concerns have been successful in reducing prices for crude oil. As long as a buyer of only a few thousand barrels daily can fix his own price, certainly there is no prospect for even stationary levels for finished products, to say nothing of rising prices on gasoline.

Within the refining division, the happening that must come about before conditions improve is that of a changed attitude toward finished products. As long as refiners continue to offer gasoline at a four-cent level in the Mid-Continent, with prices in other areas based on that figure, there can be no improvement in the oil situation.

It is doubtful if the refining division could show a profit from four-cent gasoline if crude oil came as a gift. Still numerous concerns seem not only willing but also anxious to sell gasoline on that bases.

There is a great deal of talk about higher gasoline prices but very little action to support it. Instead the action gives every evidence that refiners are bent on manufacturing gasoline and selling it, regardless of profit. The old bug-a-boo of volume still pervades the whole industry and the refiner is not immune from its sting.

Late in February there were indications that the wholesale price of gasoline in the Mid-Continent would dip well below four cents. So instead of being ready for a turn upward, on the score of price, the petroleum industry is still looking downward.

A similar situation exists in the retail price structure. Recent changes have been downward in service station postings. Whether these mark the end of reductions is questionable.

All in all it seems that the petroleum industry will not show improvement until it has recorded more disaster.

There is hope in the fact that the bottom can not be far away. Refinery gasoline at four cents and under has very little distance to move downward. With crude oil well under $1 a barrel, and in some areas 50-cent oil, certainly it is approaching the point of resistance.

Refiners Discuss Economic Situation

By GRADY TRIPLETT

ECONOMIC affairs within the petroleum industry and legislative programs which may come before the next congress held the attention of the Western Petroleum Refiners Association in its annual meeting, which opened March 10 to continue through March 12, at Excelsior Springs, Missouri.

The greater part of the economic discussion centered around the status of gasoline stocks and their relation to the report of committees earlier in the year. It was pointed out that stocks of gasoline at the end of February were 5,383,000 gallons more than the figure set as desirable by the Economics Committee of the Federal Oil Conservation board. The East Coast and the Pacific Coast were charged with the greater part of this excess.

Although no vote was taken, it was the sense of the meeting that Mid-Continent refiners should keep stocks within the total dictated by possible markets, regardless of what other refining sections may do.

L. R. Crawford, president of the association, said he thought each refining concern and each refining group should conform to sound economic law, even when others carry stocks in excess of sound economic law.

The conduct of the new gasoline pipe lines in regard to marketing methods was brought before the meeting by R. W. McDowell, vice president of Mid-Continent Petroleum Corporation, one of the six owners of the Great Lakes Pipe Line Company. Mr. McDowell said that each owning company would continue to sell its pipe line gasoline by methods and on contracts identical with methods previously used when selling gasoline shipped by tank cars. He said the owning concerns had volume within the pipe lines' territory equal to twice the capacity of the system.

"None," he said, "will change past policies or practices in regard to selling methods." A letter was read from E. B. Reeser, chairman of the board of the Great Lakes Pipe Line Company, to the effect that owning concerns had no thought of increasing volume in the area of the pipe line or of changing selling methods.

Exports had serious consideration and it was brought out that the inland refining groups can expect no export gasoline sales so long as Russian and Roumanian oil is available on conditions which now exist. George D. Locke, vice president of The Barnsdall Refineries, Inc., said he recently had inquired about exports and had come to the conclusion that even Atlantic seaboard and Gulf Coast refining plants will be shut out of export sales for a period. He said further that the new tariff regulations would deny American refineries the 170,000,000 gallons of gasoline which formerly went into Canada.

P. M. Miskell, general manager of the Empire Oil & Refining Company, said: "It seems certain that Russia will produce 100,000,000 barrels of gasoline next year. Even their highest estimate is that Russia will use no more than 40,000,000 barrels. The remainder will go into European countries at prices which deny the United States any part in that business. Roumania will add still further to their gasoline, which will shut us out of Europe."

The political situation was reviewed by Fayette B. Dow, Washington counsel of the association. He said the political situation concerning the petroleum industry is more serious today than at any time since the agitation which resulted in the dissolution of the Standard Oil Trust.

Mr. Dow said that the efforts to gain a restriction of imports on oils from South America finally met defeat at the hands of the congressmen from the New England States, whose objection centered around fuel oil. When next introduced he added that fuel oil would have to have special consideration before any form of oil tariff could be adopted. He reported that there is likelihood of an investigation of the whole oil industry being ordered by congress at the next session, provided the house of representatives is organized by the democratic party, something which is highly possible. Mr. Dow dealt further with the efforts of the railroads to gain legislation affecting pipe lines.

The association adopted a resolution on the death of F. A. Pielsticker, former president of the association. A further tribute was paid by Fayette B. Dow.

By-laws of the association were changed to allow the annual meetings to be held at any time in March or April in accordance with the decision of the board of directors.

(*Continued on page* 152)

Atmospheric and Vacuum Distillation of Mid-Continent Crude

By JOHN PRIMROSE
Vice President, Foster-Wheeler Corporation

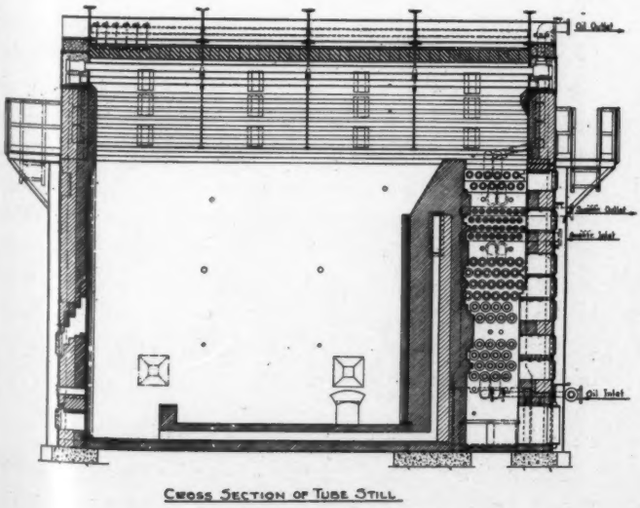
THE accompanying paper by Mr. Primrose was read before the convention of the Western Petroleum Manufacturers Association at Excelsior Springs, Missouri, March 11. The discussion deals with the development of processes and equipment applicable to asmospheric and vacuum distillation methods.

PRELIMINARY to the consideration of some actual operating results obtained in processing Mid-Continent crude, the following brief description of equipment is presented inasmuch as the features which will be referred to have a direct bearing on the results obtained.

It is necessary to heat the crude to temperatures approaching 800°F., or in some cases even higher to drive overhead the last of the lubricating stock contained in the crude. The construction of the heater is of prime importance to enable these temperatures to be reached without destroying some of the valuable products which are the most easily overheated.

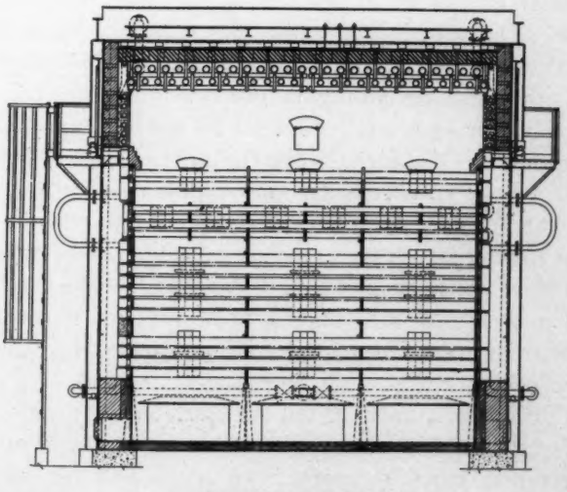
Another requirement is high overall thermal efficiency of the heater to insure the minimum fuel consumption, and, in addition, the heater must respond readily and positively to changes in adjustment without being over sensitive to small fluctuations in operating conditions, which it is impossible to avoid entirely in plant operation. Cuts No. 1 and No. 2 represent late development in a design now in successful operation which is the result of gradual development, extending over the past 10 years, to meet more and more exacting requirements.

In the earlier designs heat was absorbed from the furnace almost entirely by convection, whereas today nearly all of the heat is absorbed by radiation, and convection is only used to recover heat remaining in the furnace gases after they have been cooled to comparatively low temperatures as a result of heat absorbed through radiation. Radiant heat absorbing surface is exposed directly to flame radiation and must be sufficient in extent to prevent too high a transfer rate to the oil when the quantity of air supplied for combustion is barely sufficient to insure complete combustion of the fuel. This surface must be located at some distance from the burning fuel so that flame impingement is prevented and concentration of heat rays is avoided. Even distribution of



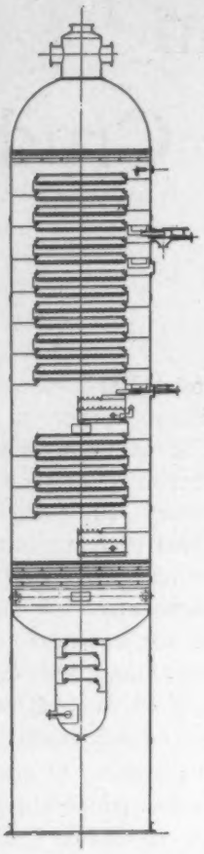
CROSS SECTION OF TUBE STILL

CUT NO. 1

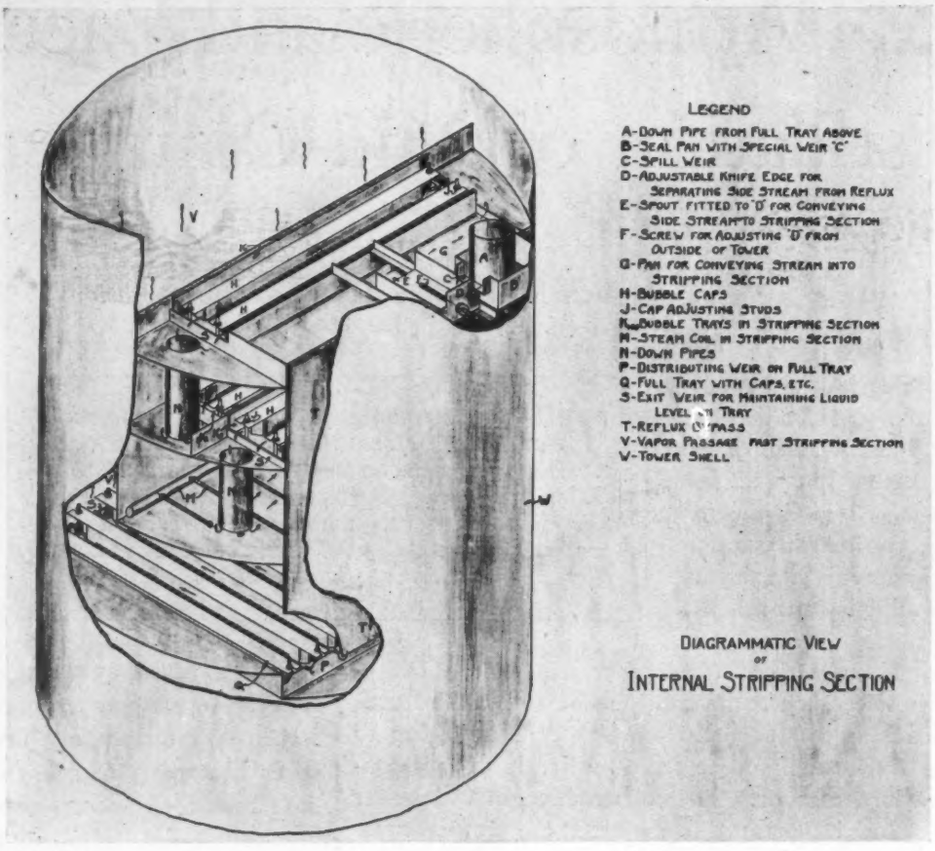


CROSS SECTION OF TUBE STILL

CUT NO. 2



CUT NO. 3


LEGEND
A-DOWN PIPE FROM FULL TRAY ABOVE
B-SEAL PAN WITH SPECIAL WEIR 'C'
C-SPILL WEIR
D-ADJUSTABLE KNIFE EDGE FOR SEPARATING SIDE STREAM FROM REFLUX
E-SPOUT FITTED TO 'D' FOR CONVEYING SIDE STREAM TO STRIPPING SECTION
F-SCREW FOR ADJUSTING 'D' FROM OUTSIDE OF TOWER
G-PAN FOR CONVEYING STREAM INTO STRIPPING SECTION
H-BUBBLE CAPS
J-CAP ADJUSTING STUDS
K-BUBBLE TRAYS IN STRIPPING SECTION
M-STEAM COIL IN STRIPPING SECTION
N-DOWN PIPES
P-DISTRIBUTING WEIR ON FULL TRAY
Q-FULL TRAY WITH CAPS, ETC.
S-EXIT WEIR FOR MAINTAINING LIQUID LEVEL ON TRAY
T-REFLUX BY-PASS
V-VAPOR PASSAGE PAST STRIPPING SECTION
W-TOWER SHELL
DIAGRAMMATIC VIEW OF INTERNAL STRIPPING SECTION

CUT NO. 4

heat rays over the surface exposed to radiation is advisable to secure uniform heating.

The furnace gases having been cooled through radiation are then passed rapidly over the tubes of the convection bank, through which the oil to be heated flows in a direction contra-flow to the furnace gas. Thus the furnace gases are cooled to within nearly 100°F. of the temperature of the oil entering the heater and 70 to 80 per cent of the heat value of the fuel is absorbed by the oil. In cases where the temperature of the oil entering the heater is above 550° F., the heat remaining in the flue gas after leaving the heater is often recovered by preheating the air supplied to the furnace for combustion.

Furnace volume is an important consideration, and it has been found desirable in practice to provide for a considerably lower rate of heat liberation than is used in boiler practice. This avoids the intense heat of a boiler furnace and insures uniform absorption essential to uniform and well controlled heating of the oil.

This requirement often necessitates furnace walls of considerable area. These are constructed of the sectional type, supported on steel and air cooled when the service required of the heater necessitates frequent starting and shutting down. Otherwise solid walls of good material, strongly bonded but with ample provision for expansion will last indefinitely.

When heating oil to near the critical temperature, it is desirable to supply latent heat of vaporization in the heater as vapor is formed. Otherwise it would be necessary to heat the oil beyond the temperature required to produce the desired vaporization because the latent heat required in the flash chamber can only be supplied by heating the oil in the heater to a temperature in excess of that which is necessary in the flash chamber for the desired vaporization. By supplying latent heat of vaporization in the heater, the final temperature to which it is necessary to heat the oil is less, but it is necessary to provide room for the increasing volume of oil and oil vapor as vaporization takes place. Otherwise vaporization would be suppressed by the pressure generated. More area for the oil and vapors is provided by using tubes of larger diameter as the outlet of the heater is approached, at which point the greatest volume of vapor exists.

COLUMN ASSEMBLY

From the heater the hot oil and vapors pass to a vapor separating and fractionating tower of which Cut No. 3 is a typical example, although of a type used for vacuum distillation. Oil and vapor enter

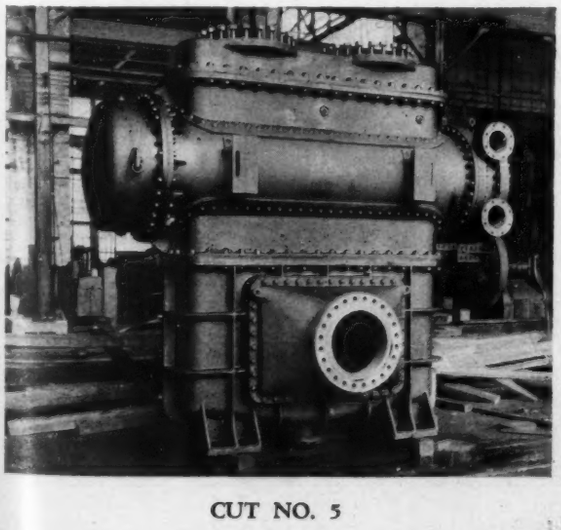
the tower tangentially below the first baffle assembly where the liquid is separated and drops toward the bottom of the tower, passing over several trays in the bottom section of smaller diameter where, in its downward path, it encounters a current of steam, and so it is stripped of light fractions. A float indicator is used to regulate the liquid level which, together with the reduced diameter, insures the hot bottoms being removed from the tower in the shortest possible time. The rising vapors pass through the first baffle assembly and flow on upward through a series of bubble trays. The heavier vapors are condensed by contact with reflux and removed as side streams and only the lightest vapors reach the top from which they are removed through the vapor line to heat exchangers and condensers.

The top of the tower temperature is controlled by pumping back condensate onto the top tray, producing reflux which flows downward from tray to tray gradually becoming heavier. At intervals in the downward flow of the reflux, side streams are withdrawn either direct from the plate or after passing through stripping sections where, out of contact with vapor passing upward through the tower, the side stream to be removed is stripped of light fractions by steam. The balance of the reflux not removed as a side stream is by-passed around the stripping section and continues down through the tower. The quantity of the side stream removed is controlled by an adjustable valve which can be set to remove a predetermined proportion of the reflux quite independently of the total quantity flowing down the tower. Thus the valve once set for a given set of operating conditions, it is only necessary to pump back onto the top plate enough condensate to maintain the proper top of tower temperature, as the side stream will automatically, because of these control valves, accommodate themselves to varying quantities of vapor passing up and reflux flowing down. This arrangement serves to greatly steady the operation of the tower, and requires less supervision and changes in adjustment when the throughput varies. The only points of control are then, the heater outlet temperature and the temperature at the top of the tower. The tube still outlet temperature is under the control of the stillman. The top of tower temperature is controlled automatically by instruments provided for that purpose .

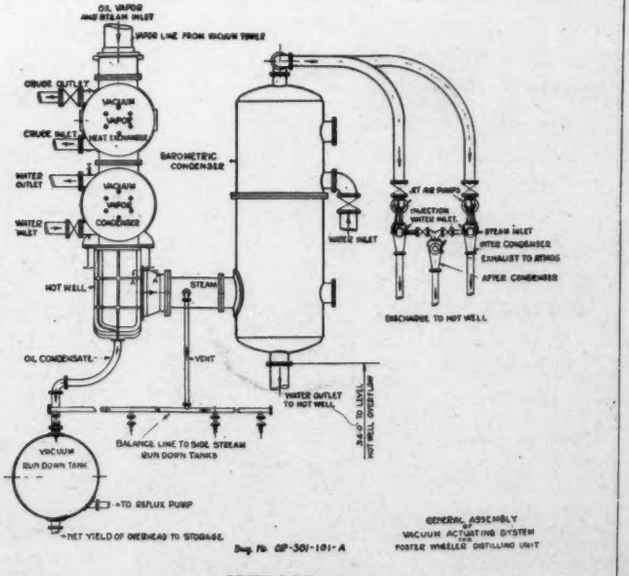
STRIPPING

A detail of a stripping section previously mentioned above is illustrated by Cut No. 4, which shows diagrammatically the general arrangement with relation to the tower. Less ground space is required when internal stripping sections, as illustrated, are used. Where strippers outside the tower are used, additional steam must be supplied to make up the heat lost by radiation. The chief advantage of the outside stripping section is when the point of take-off of the side stream is uncertain. In each type of stripper the reflux removed as a side stream flows down over a series of trays meeting an upward flow of superheated steam which gently heats the oil and reduces the oil vapor pressure. The lighter oil vapors and steam are returned to the tower immediately above. The inside arrangement keeps the stripping section in contact with oil and steam vapor slightly warmer than the oil contained, and thereby conserves steam.

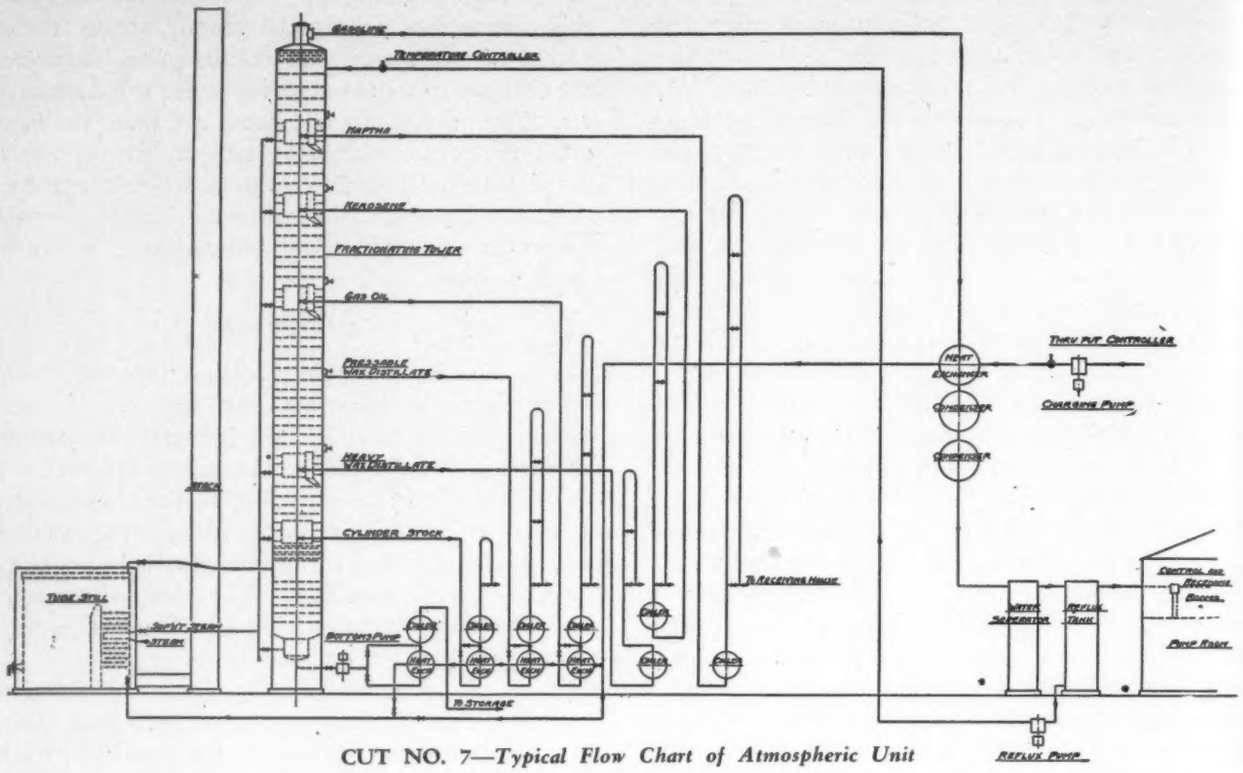
The tray construction of the tower is also illustrated by Cut No. 4. It is important to have a uniform flow of liquid over the plate to insure thorough contacting of the ascending vapor with down flowing reflux. The plates are therefore made up of rectangular sections containing long narrow nozzles covered with caps of the same shape. The space



CUT NO. 5



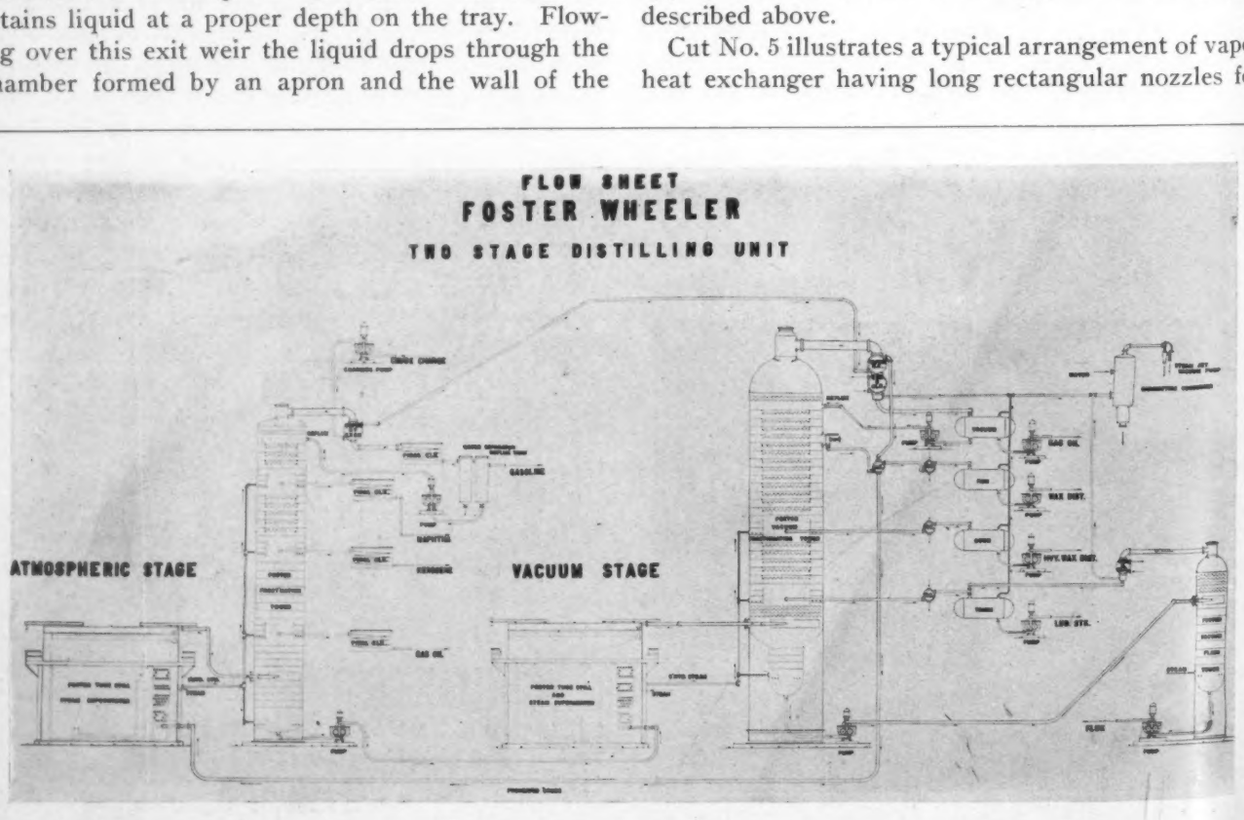
CUT NO. 6



CUT NO. 7—*Typical Flow Chart of Atmospheric Unit*

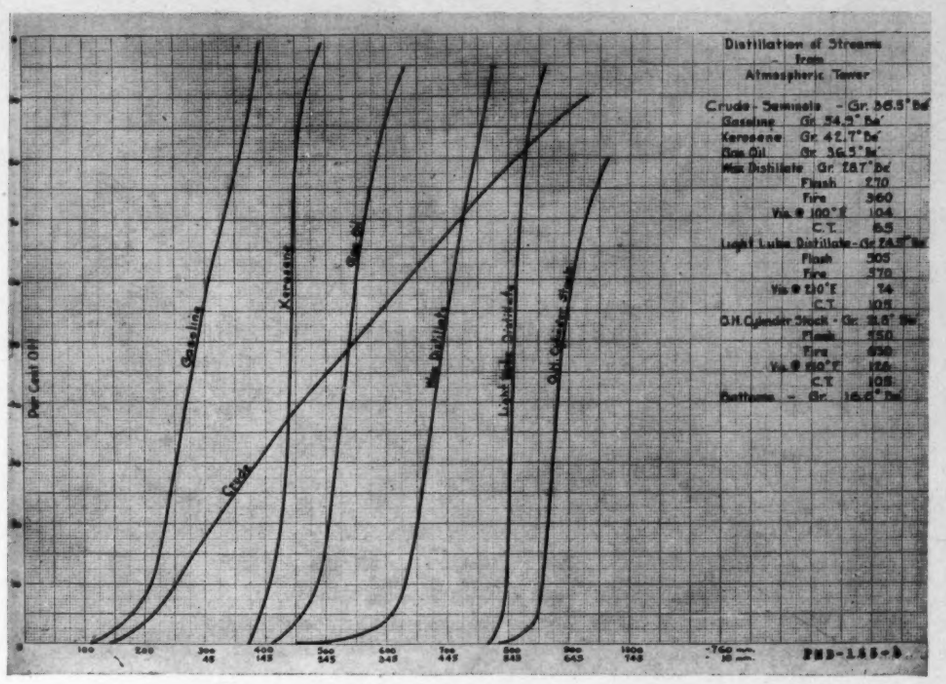
between the rectangular sections and the wall of the tower is filled in with cast iron or wrought steel pieces of suitable shape, or is used as down-comers. A notched weir evenly distributes the liquid at the entrance side of the plate and a weir at the exit side retains liquid at a proper depth on the tray. Flowing over this exit weir the liquid drops through the chamber formed by an apron and the wall of the tower into a seal pan and so across the plate below in the opposite direction. The arrangement of trays with down-comers is also illustrated in Cut No. 3, although the down-comers as indicated are not the type used, but in the tower they are arranged as described above.

Cut No. 5 illustrates a typical arrangement of vapor heat exchanger having long rectangular nozzles for



CUT NO. 8

good distribution of vapor over the tubes of the cooling surface without excessive drop in pressure due to friction or baffles. This is important in atmospheric stills, but even more so in vacuum stills where it is essential to maintain the absolute pressure at the point of flash as low as possible. At the bottom a chamber is fitted for separation of oil condensate from non-condensable gas or steam. The oil is withdrawn from the nozzle at the bottom and the non-condensable gases and steam are removed through the side nozzle. This type of condenser is chiefly used in vacuum stills where gas oil is condensed at a temperature above that of the steam and non-condensable gases which pass to the barometric condenser and steam jet vacuum pumps. Cut No. 6 illustrates a typical assembly of a vacuum actuating system.



CUT NO. 9

Cut No. 7 illustrates diagrammatically a typical arrangement of an atmospheric unit running to heavy flux bottoms, taking cylinder stock overhead as a side stream. This arrangement is typical of a single flash distillation using the lighter vapors to reduce the vapor pressure of the heavier fractions, permitting vaporization of the heavier oils at a lower temperature than would be possible had the lighter vapors been removed. However, for most Mid-Continent crudes, even when retaining the lighter vapors, the temperature required to recover all of the cylinder stock is still too high to insure good color stability in the gasoline and kerosene. But by the addition of a chamber into which the bottoms after being withdrawn from the atmospheric tower are flashed under vacuum, a very satisfactory yield of cylinder stock can be obtained at temperatures not harmful to the color of the lighter streams. The application of this auxiliary flash chamber is illustrated in Cut No. 8, although in this cut the auxiliary flash chamber is attached to the vacuum tower but its application to an atmospheric tower is essentially the same.

Cut No. 8 illustrates a two-stage atmospheric and vacuum unit in which the maximum yield of cylinder stock overhead can be secured from any type of crude without endangering the color of light overhead products. These are removed in the atmospheric tower at a temperature not exceeding 600°F. The bottoms usually including gas oil are then passed hot to the heater of the vacuum stage and their temperature increased to evaporate the heaviest lubricating stock. For some Mid-Continent crudes 770-778°F. is sufficient. Others, such as Kansas, require temperatures exceeding 800°. Fortunately, such crudes do not break and crack easily under such temperatures.

TWO STAGE FLOW

The flow through such a unit is illustrated in Cut No. 8. On this unit the vacuum tower is supplemented by a flash chamber into which the bottoms from the vacuum tower pass and are flashed under a somewhat lower absolute pressure than can be obtained in the main tower at the point of flash because of the pressure drop necessary to pass the vapors through the bubble trays to obtain good fractionation. The auxiliary tower is direct connected through a condenser to the jet condenser and steam jets, thus producing a lower absolute pressure at the point of flash than in the main tower. The overhead cylinder stock is condensed and combined with the cylinder stock from the stripping section of the main tower.

TABLE NO. 1

Performance Data on an Atmospheric Unit

Thruput—Seminole crude .....6300 B/D
Gravity .....39.7° A.P.I.
Temp. tube still inlet.....350°F.
Temp. tube still outlet.....800°F.
Temp. superheated steam .....750°F.

	Yield %	Gravity °A.P.I.	Color	E.P. °F.
Gasoline	39.5	60.0	30+	442
Kerosene	4.4	41.4	17	...
Gas Oil	25.1	36.0	..	...
Wax Distillate	10.3	29.6	..	...
Cylinder stock	8.7	...	Vis. @210°F. 98	...
Bottoms	9.8	12.0	..	...
Loss	2.2	...	..	...

Table No. 1 presents data obtained on an atmos-

pheric unit when running Seminole crude to flux bottoms.

The addition of a flash chamber increased the yield of cylinder stock from 8.7 per cent to 13.4 per cent, the cylinder stock from the vacuum chamber having a viscosity of 138 seconds at 210°F. The bottoms were reduced to 6.5 per cent. The conclusion drawn from the data presented may well be that to always insure good color of the lighter products, as well as an increased yield of overhead cylinder stock of higher flash, a vacuum flash chamber should be installed as an auxiliary to the main tower.

The curves in Cut No. 9 are made from distillation of samples of streams recovered from atmospheric distillation of Seminole crude when running to 15.9 per cent bottoms with a tube still temperature of 750°F. At this temperature the color of the gasoline was 30+, and the kerosene 24. At higher temperatures the color of these streams gradually fell off, and at 800°F. tube still temperature the gasoline was 22 color and the kerosene 17 to 18 color.

A four day run on Seminole Mid-Continent crude through a two-stage atmospheric and vacuum unit, like that illustrated by Cut No. 8, using an auxiliary vacuum tower to flash the bottoms from the main vacuum tower is tabulated in Table No. 2.

The yields for a corresponding run with Seminole crude without the flash tower are tabulated in Table No. 3.

TABLE NO. 2

Performance Data on Two-Stage Atmospheric and Vacuum Units with Auxiliary Flash Tower

Temperature °F.		
Oil ent. atmos. tube still		361°F.
Oil lvg. atmos. tube still		599°F.
Oil ent. atmos. tower		572°F.
Vapors top of atmos. tower		303°F.
Oil ent. vacuum tube still		528°F.
Oil lvg. vacuum tube still		774°F.
Oil ent. vacuum tower		750°F.
Vapors top of vacuum tower		407°F..
Oil ent. flash tower		687°F.
Vapors lvg. top flash tower		678°F.
Bottoms lvg. flash tower		676°F.
Thruput (2 units)	27130 B/D	
Fuel used (by volume)	2.36%	
Steam Used (2 units)		
Total live steam (pumps and jets)	17664 lb./hr.	
Total exhaust steam used	17166 lb./hr.	
Water used	5980 G.P.M.	
Yields		
Total Crude	27130 B/D	100.00%
Gasoline	7724 "	28.47
Kerosene	4024 "	14.83
Gas Oil	2844 "	10.48
Wax Distillate	7263 "	26.77
Hvy. Wax Distillate	1862 "	5.17
Cylinder stock	1862 "	6.86—150 vis @ 210°F. F1.O.C.—535°F.
Flux	1870 "	6.89—10.1°A.P.I.,108 M.P.
Loss	140	.53

It is evident from Tables No. 2 and No. 3 that to obtain the best color of light products and the maximum yield of cylinder stock a two-stage atmospheric and vacuum unit, supplemented by a vacuum flash tower as an auxiliary to the main vacuum tower, is required. However, the increased yield of cylinder stock is so small that the advisability of the increased investment would depend largely on specific conditions.

Table No. 4 lists the performance when running various crudes in a two-stage atmospheric and vacuum still similar to that shown in Cut No. 8, but without the auxiliary flash tower.

TABLE NO. 3

Yields from Two-Stage Atmospheric and Vacuum Unit without Auxiliary Vacuum Flash Tower

Yields		
Total crude	13518 B/B	100.00%
Gasoline	3865 "	28.6
Kerosene	1620 "	12.0
Gas Oil	1810 "	13.4
Wax Distillate	3705 "	27.4
Wax Slop	568 "	4.2
Cylinder stock	758 "	5.6—151 vis @ 210°F. 525°F. flash
Flux	935 "	6.9—11.1° Be' 94 M.P.
Loss	257 "	1.9

TABLE NO. 4

Performance Data on a Two-Stage Atmospheric and Vacuum Unit When Processing Various Crudes

Test Number	1	2	3
Kind of Crude	Venezuela	Caddo	Oklahoma City
Gravity of crude—°A.P.I.	17.7	23.7	38.2
Duration of test—hrs.	120	16	120
Thruput—B.P.D.	11870	9480	8520
Fuel used—% thruput	1.64	....	2.31
Temperatures—°F.			
Oil ent. atmos. tube still	330	380	340
Oil lvg.. atmos. tube still	615	590	580
Vapors top atmos. tower	252	285	225
Steam ent. atmos. tower	780	725	700
Oil ent. vacuum tube still	570	525	510
Oil lvg. vacuum tube still	650	810	820
Vapors top vacuum tower	...	325	325
Steam ent. vacuum tower	575	725	675
Steam Used—Lb. Hr.			
Total live steam	9300	....	8830
Exhaust steam atm. tower /G. crude	.06	....	....
Exhaust steam vac. tower per gal. reduced crude	.14	....	....
Water Used—G.P.M.	2540	....	2540
Yields—%			
Naphtha	6.91	1.46	30.14
Refined oil	8.81	5.13	20.75
Gas oil	16.39	29.26	5.16
Light Lube "A"	13.98	....	....
Heavy Lube "B"	3.66	....	....
Motor oil	....	42.14	....
Paraffine Distillate	....	....	24.80
Cylinder stock	....	4.07	9.32
Heavy flux	49.13	18.35	9.08
Gas and loss	1.12	+.41	.75

Successful runs were also made on Lago crude running to ..... 50-60 Pen. Btms.
80-100
100-120
900-1200 Vis. Btms.
470-490 flash Btms.

The range of operation shown by Table No. 4 indicates the flexibility of this construction, which is largely the result of positive control of the heater and tower. The design and arrangement of bubble trays and stripping sections, and the weir type of control valves used are largely responsible for close control of fractionation. It is evident from data submitted that a unit of this type can function economically over a wide range of operations from light topping at one extreme, to running to heavy flux bottoms at the other, requiring only a slight change in adjustment. Such a unit therefore can be considered as a general utility unit, and thus marks a distinct increase in usefulness over the earlier types of tube still and tower which were definitely limited to a specific performance.

Pressure Distillate Stabilization And Gas Recovery Systems

By A. W. BURKET
Jackson Engineering Corporation

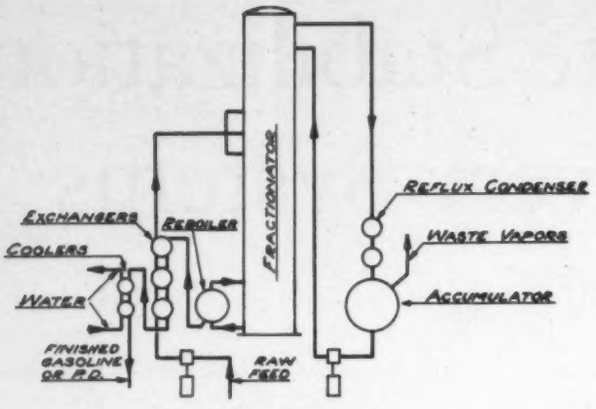
THIS paper, read before the annual meeting of the Western Petroleum Refiners Association at Excelsior Springs, Missouri, March 11, 1931, will discuss pressure distillate rectification plants and refinery vapor recovery plants. First attempt will be made to show the necessity for a complete preliminary plant survey before the installation of any system designed for maximum profit can be made. Second, basic flow diagrams will be presented and indications will be given of the most important considerations in modifying these flow diagrams toward development of the most economic process. Third, a few of the factors will be presented which should control the design of equipment.

The preliminary plant survey should be made by competent and experienced engineers working in close co-operation with the refinery management. The advent of fractional distillation analysis has made it possible to accurately determine quantitatively all the vapor losses in the refinery. It has made it possible also to determine quantitatively the undesirable hydrocarbons present in light distillates, which can be removed and replaced by desirable hydrocarbons. It is now possible to predict with certainty the savings which can be effected by changes in handling methods in the fractionation of pressure distillates, or in the proper treatment of vapors.

In addition to the development of rational analysis methods, the research engineers of the industry have developed accurate and rational methods for calculating the physical problems of absorption, distillation and fractionation.

These two developments, quantitative analysis and rational methods of calculation, make it possible for the experienced engineer to accurately select equipment for any vapor recovery or light distillate fractionation problem.

VAPOR losses in any refinery can be divided into two general classes, preventable losses and non-preventable losses. By preventable losses are meant those losses which can either be reduced in quantity or prevented entirely by more efficient refining methods. By non-preventable losses are meant those overhead vapor losses which of necessity do occur under the most efficient refining methods. So in studying all vapor losses it is necessary to not only determine the volume of each source of loss but also endeavor to determine the cause of each loss without the thought of possible prevention or reduction of this loss. In many cases preventable losses can be traced to the lack of an adequate water cooling system. In general it is considered economic to cool the circulating water to within 5 to 10° F. of the wetbulb temperature, which wetbulb temperature in very few places in the United States, with the exception of the Gulf Coast region, exceeds 75° F. average during July and August. Yet it has come within the observation of the writer that 90° F. and 95° F. water is not uncommon in the summer time, and in a few instances 100° F. and 105° F. water. With these water temperatures the volume of vapors must necessarily be high, and consequently the treating of these vapors for the recovery of valuable hydrocarbons is not only inefficient but unduly high in cost. It means not only the circulation of more absorption oil because of greater vapor volume, but also the circulation of more oil because of high oil temperature. Some refiners have endeavored to avoid stabilization of their light distillate streams by purposely operating with high condenser temperatures. This has effected a fairly stable product in the gasoline streams produced from the crude units; first, because the crude contains very little propane; and second, because of the low operating pressure. But in the distillate produced by cracking large quantities of propane are present and the losses of valuable butanes are heavier due to high condenser temperatures are not commensurate with the slight reduction of propane that will be effected in the distillate. This is a physical law based on the fact that the vapor and liquid in any accumulator approach equilibrium to each other, and since the condensing pressure in cracking plants is always higher than in crude distillation plants, and the quantity of propane greater, the condensate produced will always contain propane in objectionable quanties even



TYPICAL DEBUTANIZER OR GASOLINE FRACTIONATOR

FIGURE 1

should the condensing temperature be as high as 140°-150° F.

This propane existing in cracked distillates can effectively and economically be removed only by fractionation, and now before proceeding with the discussion as to methods of removing this propane I wish to present some representative analysis of pressure distillates.

Pressure Distillate at Atmospheric Pressure		Pressure Distillate at 30 Lbs.	
Constituent	Mol %	Constituent	Mol %
Ethane	.33	Methane	.02
Propanes	3.40	Ethane	.24
Butanes	8.43	Propane	1.63
Pentanes	10.93	Butanes	9.39
Hexanes and heavier	76.91	Pentanes	13.11
A.P.I. gravity at 60°	52.6	Hexanes and heavier	75.61
		A.P.I. gravity at 60°	58.2.

Pressure Distillate at 40 Lbs.		Pressure Distillate at 165 Lbs.	
Constituent	Mol %	Constituent	Mol %
Methane	.06	Methane	.47
Ethane	.69	Ethane	2.22
Propane	3.22	Propane	5.67
Butanes	9.33	Butanes	10.31
Pentanes	12.05	Pentanes	11.26
Hexanes and heavier	74.65	Hexanes and heavier	70.07
A.P.I. gravity at 60°	55.3	A.P.I. gravity at 60°	61.3.

Pressure Gasoline at 20 Lbs.		Pressure Gasoline at 40 Lbs.	
Constituent	Mol %	Constituent	Mol %
Propane	1.91	Propane	2.04
Butane	5.67	Butane	6.34
Pentane	11.05	Pentane	10.82
Hexanes and heavier	81.37	Hexanes and heavier	80.80
A.P.I. gravity at 60°	57.3.	A.P.I. gravity at 60°	55.4.

PRESSURE DISTILLATE

	at 165 lb. Mol. %	at atmospheric pressure Mol. %	at 30 lb. Mol. %	at 40 lb. Mol. %
C	.47		.02	.06
C_2	2.22	.33	.24	.69
C_3	5.67	3.40	1.63	3.22
C_3				
C_4	10.31	8.43	9.39	9.33
C_4				
C_5	11.26	10.93	13.11	12.05
C_5				
C_6+	70.07	76.91	75.61	74.65
	100.00	100.00	100.00	100.00
A. P. I.	61.3	52.6	58.2	55.3

PRESSURE GASOLINE FROM GREY TOWER

	% Vol.		% Vol.
C_3	1.91	C_3	2.04
C_4	5.67	C_4	6.34
C_5	11.05	C_5	10.82
C_6	81.37	C_6	80.80
A.P.I.	57.3	A.P.I.	55.4

These are representative samples at four different operating pressures and three different cracking systems. They all show propane in objectionable quantities.

SURVEY OF ESSENTIALS

In the stabilization of this pressure distillate there is only one basic flow diagram. It is the modification of that basic flow diagram to most economically meet the conditions existing at a particular refinery that makes the preliminary survey so essential. The particular essential items in this survey that pertain to the pressure distillate stabilization are:

1. Quantity, pressure and composition.
2. Is the operation of this stabilization plant to be incorporated with the vapor recovery plant or will it be complete within itself.
3. Steam pressure available, and its value per 1000 pounds. Cooling water and its value. Electric power and its value.
4. Is there any constant source of hot oil available which may be used as heating medium for reboiler? Temperature, quantity, viscosity and gravity of such oil.
5. Gum content of pressure distillate and effect of temperature on this gum content.
6. Corrosive properties of pressure distillate.
7. Any unusual material specifications which might effect equipment cost.
8. Existing equipment which might be utilized to advantage.

Let us consider item 2 of the above. The general trend of the industry is to incorporate the pressure distillate stabilizing operation with the vapor recovery plant and final stabilization plant. However many refineries already have installed their vapor recovery plants, and are now beginning to consider pressure distillate stabilization. In such cases it is generally necessary to remodel the vapor recovery plant. Vapor recovery plants, which were installed before pressure distillation stabilization was thought of, were in most cases designed to produce a gasoline similar in character to casinghead gasoline containing approximately 30-35 per cent by volume of butanes. It was the proper gasoline for blending at that time. But if we stabilize the cracked distillates, we have removed propane from them, and

(*Continued on page* 118)

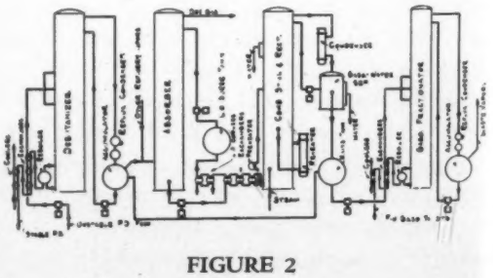


FIGURE 2

The Manufacture of Grease

Paper read before the Western Petroleum Refiners Association, Excelsior Springs, Missouri, March 11, 1931.

By F. M. SIMPSON—C. C. WILCH
Empire Oil & Refining Company

THE technique and art of grease making has not failed to keep pace with the progress recorded by the Refining Industry, and today we find modern mechanical equipment and intricate manufacturing methods in force that represent marked advancement over operations of only a few years ago. The first grease was manufactured shortly after the discovery of oil in Pennsylvania, this being a crude type of axle grease made by mixing crude petroleum with rosin oil and then adding lime water which caused the mixture to harden after a few minutes. Later various types of fillers were added as thickeners and these crude greases gave lubrication to a large variety of rough or slow moving equipment. Grease making developed slowly from that state; however, within the past few years the improvements have been rapid and today we find steam jacketed, direct fire heated, and pressure kettles, pumps, filters, temperature controlled coolers, mechanical packaging equipment and many other devices entering into manufacturing methods.

There are a great many products termed greases; however, it is the intention here to discuss principally that classification of lubricating grease most conveniently defined as soap thickened mineral oils of semi-solid and fluid consistency. The thickeners employed are metallic salts of a fatty acid of either animal or vegetable origin. This type of lubricant is, by far the most widely adaptable, and deserves more specific consideration than other classifications of popularly termed greases now found in general use.

Greases may be classified, somewhat roughly, into the following three major groups:

1. Admixtures of mineral oil and solid lubricants.
2. Blends of residuum, waxes, uncombined fats, rosin oils and pitches.
3. Soap thickened mineral oils.

The first group (admixtures of mineral oils with commonly termed solid lubricants such as Graphite, Mica, Sulphur, Talc, Asbestos Fibers, etc.) in some instances is invaluable. For the lubrication of an ill-fitting machine part, functioning under a heavy, intermitting load, at slow speed, the filler or solid lubricant, absorbs the force of impact, preventing partial metal to metal contact. Furthermore, in functioning as a filler, the solid lubricant tends to smooth any roughness of contact surfaces which may be encountered.

Examples of the type are: Tractor roller lubricants and lubricants for railway car unloading devices, concrete mixers, mechanical digging equipment, etc. They usually consist of viscous mineral oils mixed with asbestos fibers, or other fillers with a lesser degree of hardness than steel, to the desired consistency. Graphite greases, a combination of soap-oil mixtures and the type under discussion, illustrate the adaptability of the filler principle.

The second group consisting of various mixtures of viscous mineral residuum and waxes, rosins, pitch, and uncombined fats, also possesses valuable characteristics. Lubricants of this type are especially suitable for rock bit lubrication, steel cable lubrication, water pump lubrication and dredges, chain, cranes and gears operating under water or exposed to the weather. The high specific gravity and high degree of metallic adhesion offer a protection against the operating conditions encountered.

In group three, the various thickeners employed include sodium, calcium, aluminum, lead, and less frequently, potassium and zinc soaps. The soaps are prepared by the saponification of a fatty glyceride of either animal or vegetable origin.

Soap-oil mixtures are diversified with respect to adaptability to lubrication requirements. The consistency, lubricating film strength, liquefaction temperature, degree of internal cohesion, and metallic adhesion, are especially required factors of modern lubrication and these factors are within control by scientific supervision of the grease making art.

"The Sliding Layer Theory" of lubrication assumes that the lubricant forms not only one film between the rubbing surfaces, but several, microscopic in dimension. The adhesion of the lubricant to the metal surface forms the initial film. Additional films are formed by the cohesive attraction within the lubricant body.

It follows, that for various rubbing speeds a greater or lesser degree of metallic adherence and body coherence is an essential factor of lubrication. It is

readily seen that for high speed lubrication the cohesive property should not predominate, since it is a condition apt to cause momentary interruption of the lubricating film.

No method of test has been introduced for measuring the properties separately, but a study of the grease texture gives some indication of its relative qualities. A short shear or buttery texture, suggests a low degree of internal cohesion. With increased strength, the texture assumes a longer shear, graduating into an elastic or sponge-like structure.

Grease cannot be substituted for mineral oil to meet every lubrication requirement, but in many instances it is a more economical lubricant, by reason of its heavier body and higher resistance to flow. Consequently, less waste is encountered and the same lubricating results are obtained at a lower cost.

The essential restricting factor that applies to the use of grease as a lubricant for all purposes, issues from the fact that the soap forms an ash upon disintegration by combustion. The ash thus formed has an abrasive action on the parts to be lubricated, and also acts as a nucleus for excessive carbon deposit.

INGREDIENTS OF SOAP-OIL MIXTURES

The ingredients used in the manufacture of soap thickened oils include the saponifying agent or metallic base, the saponifiable oil, and the mineral oil. The manufacturing procedure, in general, is to heat the saponifiable oil in contact with the metallic base until the saponification reaction is completed. The mineral oil is then slowly worked into the hot soap until a grease of the desired consistency is made. There are some exceptions and variations to the general procedure which will be described later under the discussion of each soap type.

The saponifying agent or metallic base, obviously, determines the type of soap, and consequently plays a part in purposing the major characteristics and general physical properties of a grease product. Thus sodium and potassium soap greases are characterized by high solubility in water, and high liquefaction temperature; calcium or lime base greases by insolubility in water, and instability at high temperature wth subsequent separaton of oil and soap; lead and zinc soaps by high specific gravity and comparatively low melting point; and aluminum soap products by stability at high temperatures and brilliant, translucent appearance.

The type of saponifiable oil or fat is secondary to the saponifying agent, in importance to the construction of a grease product. The more specific properties, such as texture, degree of metallic adhesion, and cohesive character of the grease body, are controlled to a certain extent by selection of the fatty ingredient.

The grade and body of the mineral oil ingredient are largely responsible for the lubricating value of the grease product. Although viscosity is by no means a true index of lubricating value, it stands unquestioned that an extremely heavy-bodied oil possesses a stronger lubricating film than an extremely light-bodied oil. The mineral oil should be selected in accordance with the pressure and rubbing speed of the parts to be lubricated and the maximum temperature to be encountered.

Commercial fats of a known origin, generally, are sufficiently uniform to insure satisfactory results; however, in order to insure absolute uniformity, close chemical control is necessary, as changes in color, odor, melting point, acidity, or percent unsaponifiable matter will cause variations in quality in the finished product. A very satisfactory and inexpensive investigation procedure upon which to base purchase specifications is to manufacture small batches on an experimental scale and inspect the results. Proper specifications including saponification number, acidity, melting point and color should suffice to maintain quality of shipments received. A number of saponifiable oils require special, individual tests to establish their identity. These oils contain infrequently occurring members of known chemical classification, which are responsible for certain individual behavior of the soap products. Included in the group are Fish Oil, Rosin Oil, Castor, Rapeseed, Cocoanut and Linseed Oils. Control should be exercised in the purchase of lime, as variations in the strength of the lime employed would cause variation in the consistency of the resulting lime soap greases. Specifications require the absence of silica, as a high silica content will cause excessive wear in close bearings. The importance of the quality of lime has been recognized by a number of lime manufacturers in their offering to the trade special grades suitable for grease making and having the highest quality.

MANUFACTURING EQUIPMENT

Kettles are, of course, the principal items of equipment in a grease plant and may be divided into three classes: Open-type steam-jacketed kettles, closed-type steam-jacked pressure cookers, and direct-fire heated-kettles. Each of these types has its own characteristics and no one of them will serve entirely satisfactorily for the manufacture of every kind of grease. The open-type steam-jacketed kettle is the most widely used type and is applicable to the manufacture of all varieties of grease with the exception of those requiring high temperatures in their preparation. The advantages of this type are; its easy accessibility for charging and cleaning, even distribution of heat and close regulation of temperature, economical operation and freedom from hazards. The principal disadvantages are the slowness with which saponification takes place, liability of incomplete

(*Continued on page* 128)

Performance of a Modern Continuous Distillation Battery

By J. V. HIGHTOWER

THIS article presents data and yields of petroleum products from various crude runs on a modern continuous vacuum distillation battery. The distillation of a given cut of oil can be carried out at an appreciably lower temperature under vacuum than under atmospheric pressure. The prime advantage of this fact is prevention or reduction of undesirable cracking. Thus, heavy lubricating oils of high flash can be obtained. Again, the absence of high temperatures results in better colors in the heavier grades of burning oils. Cuts which, under atmospheric distillation, might have to be thrown to gas oils because of poor color, can be utilized with greater profit in the burning oil fractions. A third advantage lies in the smaller fuel bottoms yields made possible by vacuum reduction. This means greater available yields of cracking stocks. From the mechanical standpoint the employment of vacuum, by lowering distillation temperatures, results in reduced deterioration of still bottoms by heavy firing.

THE battery under consideration consists of five 14 x 40 feet atmospheric end-fired shell stills and six 14 x 40 feet end-fired vacuum stills. The atmospheric stills are used for taking off the light cuts, the naphtha and most of the burning oil. These stills are equipped with seven-foot bubble towers having about 70 six-inch Badger bell caps per plate. The towers are mounted on the condenser boxes immediately behind the stills. In the tops of the towers are partial condensers — about 280 vertical two-inch tubes approximately six feet long, set in tube sheets. The distillate vapors pass up through these tubes. Cold crude circulated around the tubes provides the partial condensation necessary for reflux, which falls back upon the top bell cap plate.

The nine-foot diameter towers for the six vacuum stills are equipped with six plates beneath the distillate collecting pan, each plate having slightly over 100 holes for bell caps. All holes are not equipped with caps, however, the number varying in the different stills. A spirally-nested bank of two-inch tubes, series-parallel connections, rests in the tops of the towers. Crude, flowing through these banks, provides the cooling necessary to knock back the uprising vapors into the distillate collecting pan below. Figure 3 shows an elevation of still, tower, and cooling coil for the vacuum stills.

Condenser coils for the atmospheric stills and cooling coils for the vacuum stills consist principally of four-inch standard pipe. Due in part to difficulty of scale-removal, no baffles are used on the water side of the coils. Cold, recirculated fresh water is the cooling medium.

FLOW OF CRUDE

Figure 1 shows a plain view of the flow sheet of the battery. The cold crude first enters through the partial condensers in the tops of the atmospheric bubble towers, the oil flowing in each in parallel and then emerging into a common header. The use of cold crude in the partial condensers serves a two-fold purpose, First, it produces the condensation of the heavier portions of the vapors, which is required for fractionation on the bell cap plates. Second, it secures preheating of the crude before it enters the charge still, which results in fuel economy. After emerging from the partial condensers, the crude, usually at a temperature of 115-120°F., then goes to a booster pump, thence in parallel flow through the condensing coils in the tops of the vacuum towers. Here again, the circulation of the crude has two functions; the first, to condense the vapors rising into the tower, and the second, to secure additional preheating. After the crude emerges from the condensing coils, usually at a temperature of 250-300°F., it passes to the first or charge still. From this still the oil flows successively down the line of stills.

In the atmospheric pressure stills the flow is maintained by one or more of the following conditions: (1) difference in oil levels, (2) use of open steam in varying quantities in the stills, (3) decreasing vapor pres-

sures in the stills due to the decreasing volatility of the distillates. Reference to Table 1 shows a regular decrease in the absolute pressures maintained in the vacuum stills. These differences, of course, cause the flow of oil to proceed readily here. It will be noted that open or spray steam is used to aid distillation and reduce cracking in the last vacuum still. It is also seen from Table 1 that the absolute pressure here is greater than the pressure in the preceding still. Under such condition the flow of oil is secured by use of a jet of live steam introduced in the bottoms flow line between the last two stills. The force of the steam is sufficient to maintain the movement of oil into the still of greater pressure. The residuum is pumped from the last still by means of a deep-well pump, set about 25 feet below the grade. To avoid the solidification of the oil in the water cooler, and to produce a fuel oil of desirable qualities, a lighter oil is fluxed in with the residuum and the mixture then is pumped through a water-cooled pipe coil to storage.

HANDLING VAPORS

Vapors from the atmospheric stills enter the bubble towers near the bottom. Figure 2 shows an elevation of the towers. The heaviest reflux or "knockback" returns from the base of each tower to the still. The lightest vapors, having passed up through the bell cap plates and the tubes of the partial condensers, leave the towers through two 12-inch vapor lines, condense and cool in the pipe condensers, and the condensate flows by gravity into the run-down house. Though the lines are not shown on Figure 1, provision is made on most of the atmospheric towers to return part of the cooled condensate as wash or reflux to the top plate. This wash may supplement the reflux produced in the partial condensers when, for various reasons, the volume of crude needed for the required reflux is not available. The distillates from the vacuum towers are liquids, not vapors. The vapors rise from the oil surface in the stills and condense in the top of the towers when they strike the condensing coils. The liquid then drops back upon the collecting pan directly beneath the coils. Figure 3 shows the main features of the pan.

Small duplex pumps keep the pan pumped down, the distillate being discharged by the pumps through the cooling coils and thence into the run-down house. Danger of water entering the cooling coils through leaks is prevented by having the pumps thus placed between the pans and the coils, instead of taking suction on the discharge ends of the cooling coils. In most cases, no fractionation is required in the vacuum towers, the products ordinarily being gas oils and cracking stock. However, if fractionation is desired, reflux can be obtained by either allowing the distillate to collect and overflow from the pan upon the plates below, or by returning part of the distillate as wash upon the plates. The latter method, due to accurate knowledge of the amount pumped back, is to be preferred.

The low absolute pressures in the vacuum stills are maintained by steam jet ejectors, principally of the

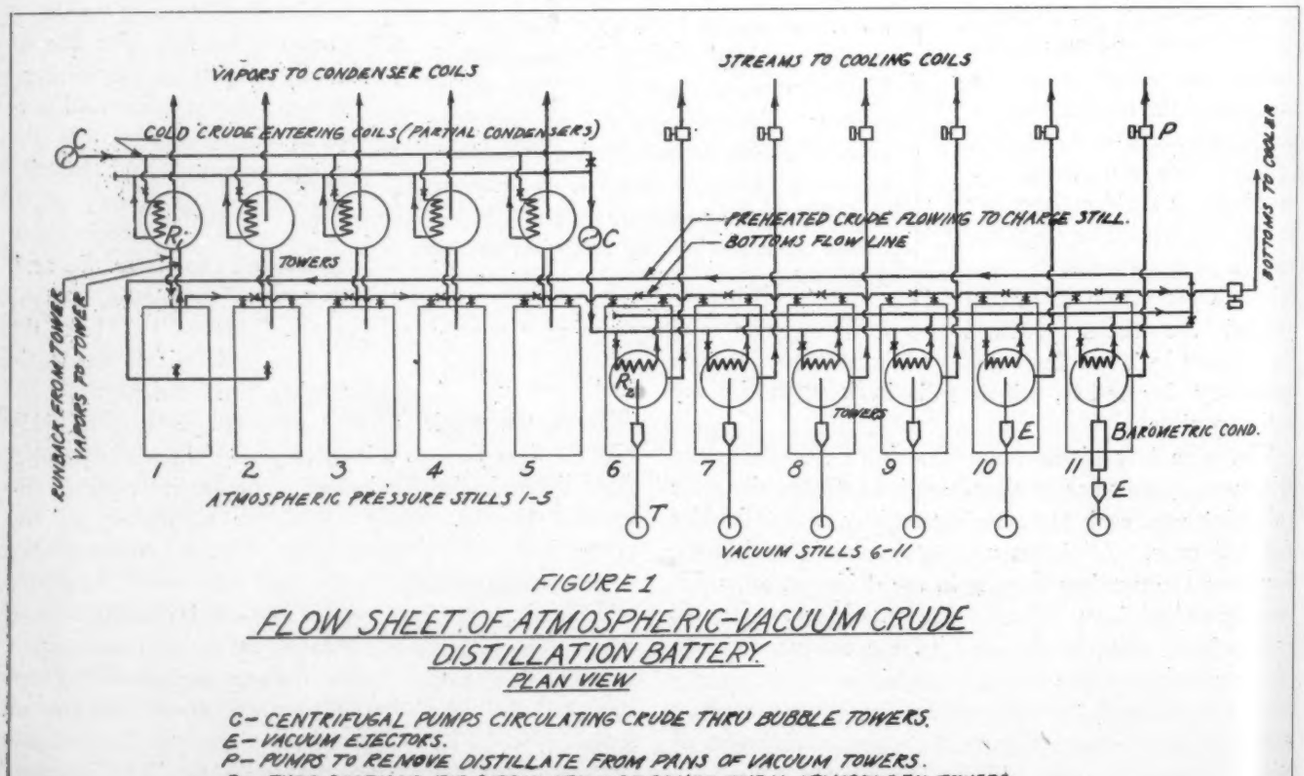


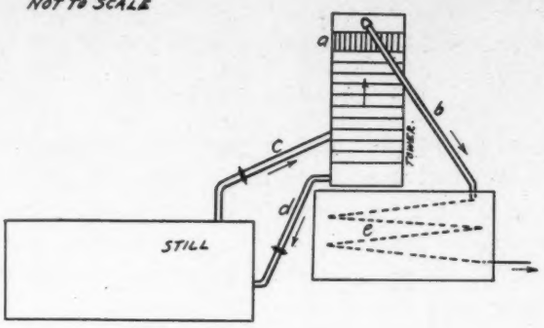
FIGURE 1

FLOW SHEET OF ATMOSPHERIC-VACUUM CRUDE DISTILLATION BATTERY.

PLAN VIEW

C – CENTRIFUGAL PUMPS CIRCULATING CRUDE THRU BUBBLE TOWERS.
E – VACUUM EJECTORS.
P – PUMPS TO REMOVE DISTILLATE FROM PANS OF VACUUM TOWERS.
R_1 – TUBE SECTIONS FOR CIRCULATION OF CRUDE THRU ATMOSPHERIC TOWERS.
R_2 – COILS FOR CIRCULATION OF CRUDE THRU VACUUM TOWERS
T – TANKS FOR EJECTOR WATER-LEG SEALS.

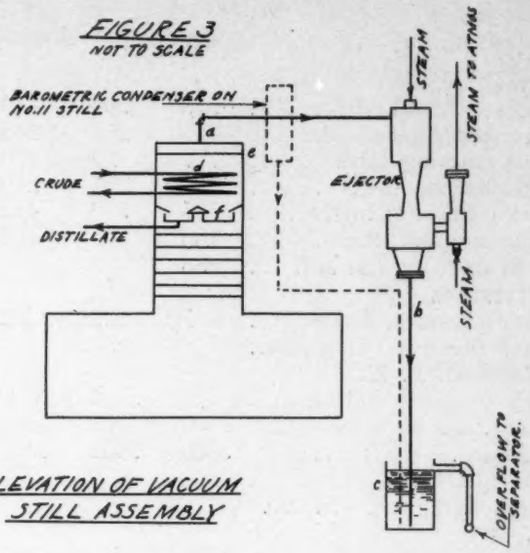
FIGURE 2
NOT TO SCALE



ELEVATION OF ATMOSPHERIC STILL ASSEMBLY

a – PARTIAL CONDENSER
b – TWO 12" VAPOR LINES
c – 18" VAPOR LINE.
d – 10" LIQUID RUNBACK
e – CONDENSER

FIGURE 3
NOT TO SCALE



ELEVATION OF VACUUM STILL ASSEMBLY

a – VAPOR LINE FROM TOWER.
b – WATER LEG FROM EJECTOR
c – SEAL TANK.
d – CONDENSER COIL
e – BELL CAP PLATE
f – DISTILLATE COLLECTING PAN

Elliott make. One spare ejector is connected to a manifold for all the vacuum stills, so that in case of failure of one of the ejectors in use, the spare can immediately be put into operation. Depending on the type and number of ejector stages of each piece of equipment (several types are in use) the steam rates vary from 700 to 1500 pounds per hour of approximately 150 pounds, 50°F. superheat steam. Water rates vary from 50 to 150 gallons per minute. Most of the ejectors can remove about 90 pounds per hour of dry air or equivalent vapors. Since air leaks in the vacuum stills or towers may seriously affect the absolute pressures obtainable, practically all seams in the metal joints and lines are welded. Figure 3 shows how the vacuum ejectors are connected to the towers.

VACUUM MAINTAINED

The ejectors, by maintaining a very low pressure at the tops of the vacuum towers, set up a pressure difference between the oil surface in the still and the region around the condensing coils in the towers. This results in a constant and rapid passage of vapors upward through the tower. The coils ("d" in Figure 3) condense all but a very small volume of air and light hydrocarbons. Test data indicate that the oils carried out through all the ejectors amount to 0.8-2.0 per cent on the crude charge. These losses naturally tend to increase with an increased charge rate to the battery, because of the greater load placed upon the vacuum tower condensing coils. The figures quoted are for a charge rate of 25,000 - 30,000 gallons per hour. The residual vapors pass up into the vacuum ejectors, through a six or eight - inch line from the top of the towers. When they strike the cold water (70-90°F.), used in the ejectors condensation of the hydrocarbons occurs, and the condensate flows down with the discharged water through the "water leg" into small seal tanks "c," about 10 feet high and four feet in diameter. The oil-water emulsion is carried out of these tanks through an overflow at the top and thence through a large manifold to a separator at the end of the battery. The seal tanks are located more than 32 feet below the ejector. This is necessary to prevent the low tower pressure from causing water to be pushed back up the water leg "b" in case of a sudden stopping of the ejector.

In the last vacuum still, where open steam is used, the volume of vapors carried up into the ejector would be so great that this equipment could not handle it and maintain a low absolute pressure. For this reason, an ordinary barometric spray condenser is placed in the line between the tower and the ejector. The barometric serves to condense all the steam, thus preventing it from reaching and overloading the ejector. The dotted lines in Figure 3 show the position of this condenser. The water discharged from it also goes into one of the seal tanks.

Several things may injure the proper functioning of the ejectors. If the condensing coils in the towers are of insufficient capacity to condense practically all the vapors, the ejector may be overloaded, thus failing to maintain a low absolute pressure. It has been found advantageous to install small water-cooled tubular vapor coolers between the tower and the ejector. In some cases the temperature of the entering vapors is so high (300-400°F.) that without this device the absolute

TABLE 1

Average Operating Data

Temps., °F.	STILL NUMBERS 1	2	3	4	5	6	7	8	9	10	11
Still	333	394	453	490	532	542	553	575	594	636	644
Tower top vapors	239	267	285	329	413	340	350	237	223	262	243
Crude entering tower	...	70	70	...	...	119	119	119	119	119	119
Crude leaving tower	...	201	219	...	...	209	359	291	254	220	280
Vapors entering tower	325	380	442	480	512	528	540	567	580	613	630
Wash entering tower	100	105	102	100	108	125					
Crude entering first still	288										
Pressures											
Tower pressure, lb./in. ga.	7	2.5	2.2	1.0	0						
Tower pressure, " Hg Abs.						12	7	3.6	1.2	1.0	1.7
Rates G. P. H.											
Crude in tower coils	0	5700	7600	0	0	6200	6500	5400	5700	5100	3800
Wash	1400	900	1500	1800	2000	1800					
Distillate	3200	5400	1300	1200	1900	1200	6000	3400	2100	1700	950
Steam, lb./hr.*	0	0	700	600	700	...	...	...	...	...	5300

Crude charge rate—34,000.

* Estimated.

pressure cannot be kept low enough. The same difficulty is encountered if the ejector spray water is not kept at 70-90°F. Air leaks in tower or still, of course, may seriously affect operation of the ejectors.

It has been found that the maximum practicable crude charge rate to the battery is about 33,000 gallons per hour. This figure holds for a crude of approximately 30 per cent naphtha content. A number of tests indicate that the limitation is imposed by the vapor capacity of the comparatively small seven-foot towers of the atmospheric stills, especially those where the naphtha cuts are removed.

OPERATING CONDITIONS

The most important factors affecting the charge capacity of a battery of this type are as follows:

Heat input capacity of the furnaces. The highest allowable input to the atmospheric still furnaces of this battery is 12 to 13 million B.t.u. per hour to the oil. The furnace efficiency averages 60 per cent. Sluggishness of flow of oil in the vacuum stills and their smaller heating surfaces make it inadvisable that these stills be fired at a rate greater than five to seven million B.t.u. per hour to the oil. Here, the furnace efficiency, due largely to the lower firing rate, is 40-60 per cent.

Vapor capacity of the fractionating towers. This depends upon the overflow capacities of the bubble plates and the cross-sectional area of the vapor passages. As soon as a vapor velocity is approached where mechanical entrainment of droplets from plate to plate occurs, the fractionation of the naphtha and burning oil cuts is impaired. With a tower of given construction and a cut of certain characteristics fixed, a maximum vapor velocity through the tower is fixed. This sets the allowable charge rate to the battery, as far as proper fractionation of the cut in question is concerned.

Condensing capacity of the coils in the vacuum towers. Unless the surface of these coils is such that they condense all or practically all the vapors striking them, serious losses to the ejectors will occur.

Condensing capacity of the atmospheric still condensing coils. On this battery the over-all heat transfer coefficient between oil vapors and water averages 12, a value low because of low water velocities and scale formation on the outside of the coils. Unless the surface of the pipe coils be large enough, insufficient con-

TABLE 2

Average Yields of Distillates and Fuel Bottoms from Various Crudes

Products—	KIND OF CRUDE North Texas	Humble	Panhandle	Ranger	Salt Flat	Heavy Coastal
Naphtha	25.0	30.0	32.2	32.0	25.0	12.0
Refined Oil	16.0	19.0	13.0	12.5	17.5	0.0
Paraffin Dist.	22.0	18.0	25.2	0.0	30.0	0.0
Gas Oil	12.0	17.0	2.0	0.0	10.7	33.0
Crack. Stock	8.0	8.5	9.2	35.0	0.0	9.0
Lube Stock*						
Fuel bottoms and gas	17.0	7.5	18.4	20.5	16.8	17.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

* For later re-running, vacuum distillation.

densation with resultant high back pressures and loss of naphtha vapors in the run-down tanks will occur.

Pump and line sizes. All equipment should be designed to take care of all probable charge requirements.

REFLUX RATIOS

The vacuum distillation battery, like all multi-still systems, does not represent the highest in fuel economy. However, such a battery has the advantage of great flexibility of operation. This is of prime importance, since it is often necessary to run many kinds of crudes on the same battery; it is a condition that may demand changes in operating conditions perhaps not possible with other types of equipment.

By changing the reflux ratio in the fractionating towers and changing the firing rate, a wide variety of streams can be taken from each still. Ordinarily, with a 30 per cent naphtha crude, the first four stills are used for taking off the naphtha. The next two stills usually remove the burning oil fraction. If a crude, such as Humble, of unusually high burning oil content is encountered, two stills may not be of sufficient capacity. In this case the naphtha is all taken off in three instead of four stills, by increased firing, and three stills can then easily handle the burning oil.

Adjustment of the reflux ratios in the towers is easily made by changing the crude rate through the partial condensers and the wash rate. Usually an over-all reflux ratio (gallons of reflux per gallon of product) of 0.7-1.0 is necessary on the stills constituting the naphtha group. This figure is for a naphtha of 32 per cent fill at 212°F., and a 100-375°F. boiling range. The burning oil group takes an over-all reflux ratio of 1.5-2.0. By varying the refluxing, products of widely different boiling ranges can be obtained. As mentioned above, little or no reflux is ordinarily required in the vacuum towers, since highly fractionated products are not, as a rule, wanted from them.

Tables 1, 2 and 3 present average operating data, yields of the most common products obtained from various crudes, and average laboratory tests on the products. These data may vary widely, depending on the character and amounts of the products required. The operating temperatures and pressures, however, will remain fairly constant in the range of the data given in Table 1.

The advantage of vacuum distillation of the heavy end of the crudes is seen from Table 4. The per cents residua given for atmospheric distillation are about the lowest that can be obtained in shell stills without excessive firing.

Table 5 shows average fuel and water rates required on the battery. Steam rates were unmeasured, but ordinarily the naphtha stills (with the exception of the first, which uses no steam) use about 0.5 pounds steam per gallon distillate, and the refined oil stills, 1.0 pounds per gallon distillate.

Difficulty has been experienced with heat recovery equipment used to recover heat of vaporization of the atmospheric still streams and heat from the bottoms from the last still. These troubles are largely due to leakage set up by heat strains and to corrosion of the tubes. The installation of properly designed equipment on a battery of this type will make possible the recovery of a large amount of heat into the crude charge and a saving in cooling water.

TABLE 3
Average Laboratory Tests on Products

Product—	North Texas	Humble	Heavy Coastal	Panhandle	Reagan	Salt Flat
Naphtha						
A.P.I. Gr..	63.0	56.0	39.9	61.0	61.5	60.3
I. B. P. ..	105	125	287	102	105	110
F. B. P. ..	363	387	541	351	370	385
p.c./212°F.	32.0	21.4	..	40.0	30.5	33.0
Refined Oil						
A.P.I. Gr..	43.0	40.0	..	42.2	41.5	43.3
Flash . ..	150	140	..	135	132	..
Vis. Ref. Oil ..	450	400	..	460	466	440
Paraffin Dist.						
A.P.I. Gr..	32.0	31.4	..	32.2	..	31.8
Flash . ..	310	295	..	280	..	310
Vis./100°F.	70	65	..	62	..	69
Crack. Stock						
A.P.I. Gr..	25.0	24.7	23.0	..	31.2	..
Gas Oil						
A.P.I. Gr..	36.3	35.5	26.4	36.3	..	36.2
Flash . ..	230	205	196	216	..	230
Lube Stock						
Flash		..	343	..	..	..
Vis./100°F. ..		..	330	..	..	..
Fuel Bottoms						
A.P.I. Gr..	16.0	16.0	..	18.0	16.2	17.0
Flash . ..	580	575	..	500	480	..

TABLE 4
Relative Reduction of Crudes with Atmospheric and With Vacuum Distillation

Crude	Vacuum*	Atmospheric*
North Texas	17.0	18.5
Salt Flat	16.8	23.0
Reagan	20.5	23.0
Panhandle	18.4	27.0

*Figures are per cent bottoms, crude basis.

TABLE 5
Fuel and Cooling Water Rates for Individual Stills

Still No.	Total fuel gas B.t.u./hr. firing rate,	Gals./Min. Water,
1	10.0	148
2	15.0	216
3	20.0	102
4	16.7	118
5	11.3	196
6	6.7	126
7	10.0	256
8	10.0	175
9	8.3	106
10	5.0	89
11	5.0	52
Total	118.0	1584

Above data based substantially on Table 1.

Sinclair's Wellsville Plant Lube Capacity Increased

SINCLAIR Refining Company, at its Wellsville, New York, refinery, completed an expansion program early this year which effected an increase in lubricating oil recovery of ten times former capacity production. The program called for the installation of new tube stills, a new contact filtration plant, a supercentrifuge plant of 40 units, a larger modern refrigeration plant and such additional auxiliary facilities as pump houses, chemical treating systems, steam generating power house and electricity generating equipment. Crude oil capacity was increased from 2500 barrels to 10,000 barrels daily.

Some of the earliest work in single flash distillation by means of pipe stills and bubble towers in processing Pennsylvania crude was done at this plant when the Sinclair Refining Company initiated its expansion program in 1927. Since that time two additional single flash distillation units have been installed, one for crude oil distillation and one for redistillation work in finishing lubricating oils. The latest addition is a 7500 barrel unit of Foster Wheeler type. The original unit and the re-run still are also Foster Wheeler design. The newest installation is equipped with a 155-foot fractionating column and designed for the removal of seven to 10 streams from the single column. The operation of this multiple stream column is simplified through the use of DeFlorez remote control valves with control centralized in the receiving house. The tube still of this unit is equipped for firing with oil, pulverized coal or pulverized petroleum coke, utilizing the Hardinge ball mill for pulverizing the solid fuels.

The principal product of the enlarged plant is lubricating oil, which in line with the modern demand, is produced with low pour test. Other products are gasoline, kerosene, cleaner's and painter's naphtha, 300 oil, furnace oil, cylinder stock, other industrial lubricants and products. The lubricating oil produced in the distillation of the crude oil is processed in a contact filtration plant, and is dewaxed by the supercentrifuge system. To secure the low temperatures desired the plant utilized 900 tons of refrigeration capacity, of Carbondale type. The mixed stock passes into the centrifuge plant chilled to minus 60°F., and here it is dewaxed through the use of 40 Sharples supercentrifuges operating at 15,000 r.p.m. Following the dewaxing operation the oil is transferred to a new Foster Wheeler redistillation unit of 8000 barrels capacity, where the solution naphtha is removed and the lubricant is finished to standard specifications. This still is equipped for burning oil, pulverized coke or pulverized petroleum coke for fuel.

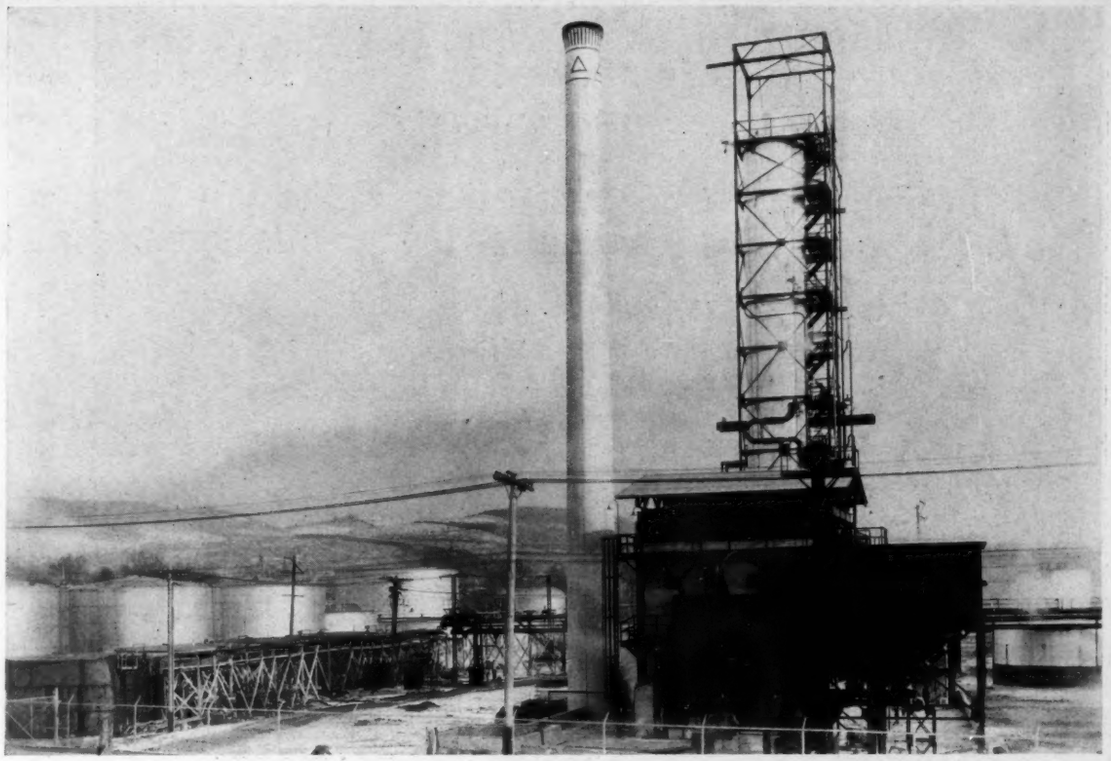
The contact filtration plant at this refinery is a departure from the usual refining practices in the Appalachian district. Decolorization of the oil is carried out at temperatures higher than usual and the product is filtered three times. Oil is handled at the contact filtration plant through Sweetland filters and through an elaborate system of heat exchangers wherein counter-flow of cool and hot oil give the incoming product about 75 per cent of its required heat before it enters the contacting system proper.

Kerosene production at this plant is treated with acid and contact clay with Sweetland filters employed for removal of the earth. The light oil treating plant for the treatment of gasoline and naphthas is designed for treatment of both straight run and cracked motor fuels. The Wellsville plant does not finish wax and this product is shipped to East Chicago for final sweating and packaging.

Construction work has been about completed on a new 2000-barrel cracking unit of two-stage type which is the final step in the enlargement program. With the exception of the furnace, which is one of the newer type DeFlorez heaters, the unit is the design of the company engineering department.

In conjunction with the enlargement of refining facilities it was necessary to erect a new steam and electricity generating plant. This plant consists of three stoker fired boilers for operation at 125 pounds pressure and two boilers for operation at 400 pounds. These larger units are automatically fired with pulverized coal and are provided with push-button control to regulate fuel feed, dampers, air fans and the like. The high pressure steam generated in the latter two boilers is passed through two Moore turbo-generators where electricity for lighting and power purposes is generated. Steam leaves the generators at 125 pounds and at this pressure is conducted about the plant to the various departments and utilized in process work.

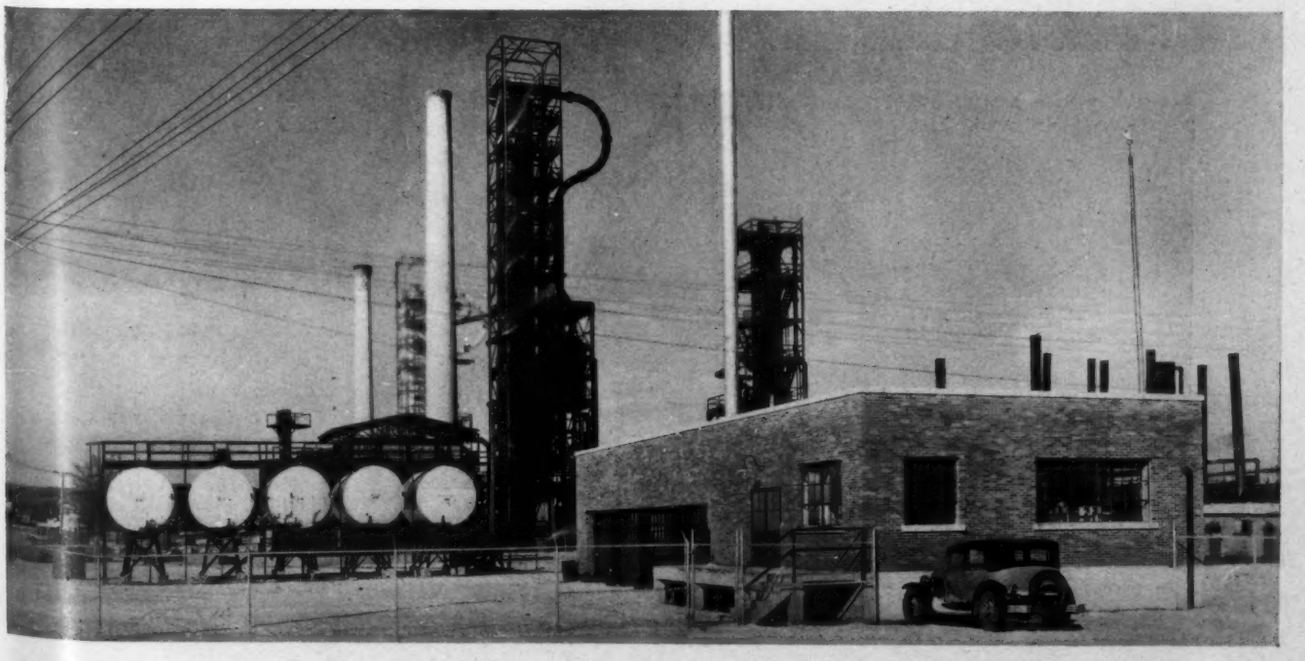
Additional construction consisted of a modern barreling plant, pipe shop and a well equipped machine shop. Car repair shops were also enlarged and more storage facilities were provided by the construction of three 80,000-barrel, one 55,000-barrel, and one 35,000-barrel tank, with the total number of tanks on the site now being 300.



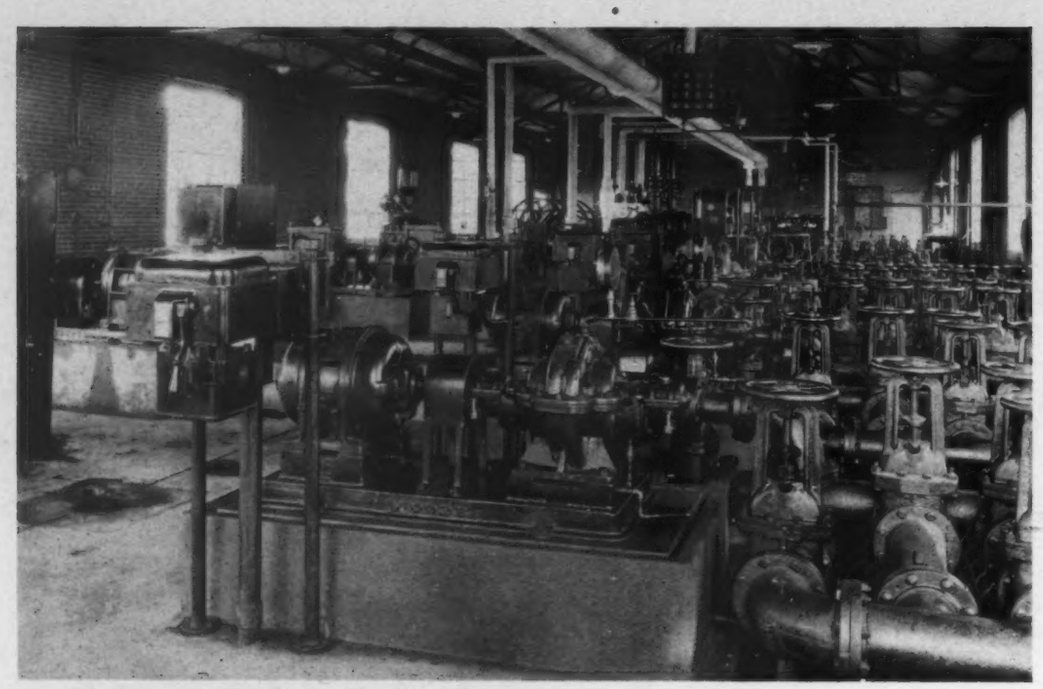
Lubricating Oil Solution Rerun Unit. Rated at 8,000 barrels daily capacity.

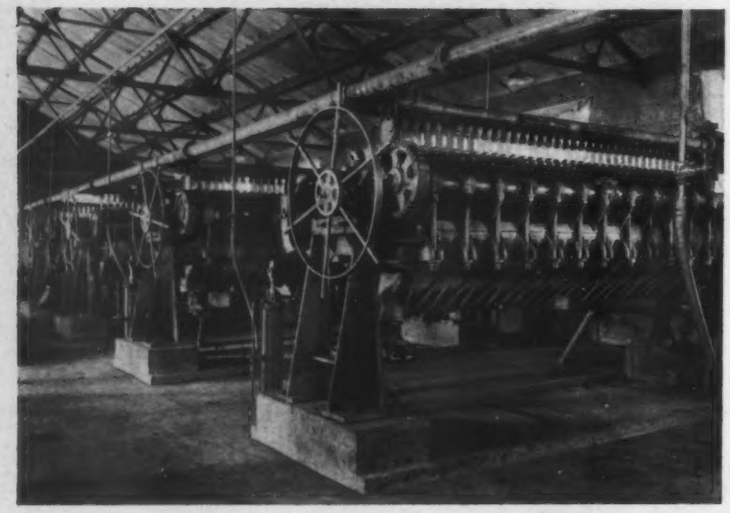
The life of this plant dates back to 1901, when it was erected by the Wellsville Refining Company (backed by the old Union Petroleum Company) and placed in operation. The original plant had a capacity of 700 barrels per day and occupied a tract of 15 acres. The present plant of 10,000 barrels capacity occupies a 100-acre site.

In 1918 the Union Petroleum Company acquired control of the company operating the Wellsville plant and operated the plant until 1921, when the Sinclair Oil Corporation acquired the business of Union Petroleum Company. Until 1927 the plant was operated much as it was before, but in that year the new owners began expanding facilities upon assurance that plenty of Pennsylvania grade crude oil was available. In 1927 Sinclair Refining Company started the expansion program which has now been completed, through the installation of the first single flash tube still unit.



General view of Sinclair Refining Company's Wellsville, N. Y. refinery. Crude Oil Distillation Units.

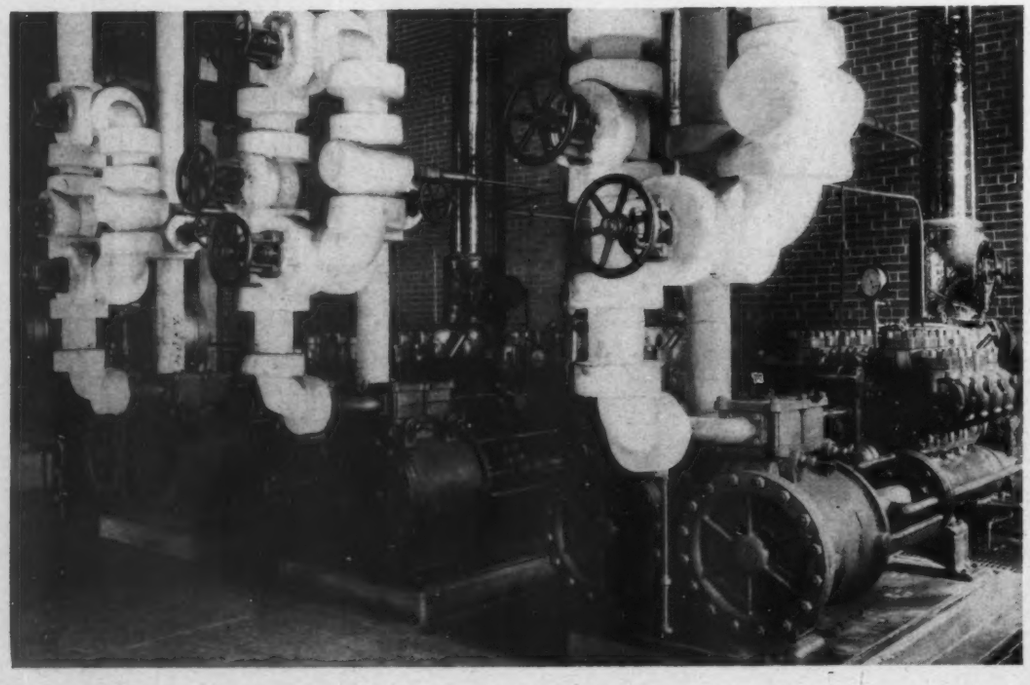


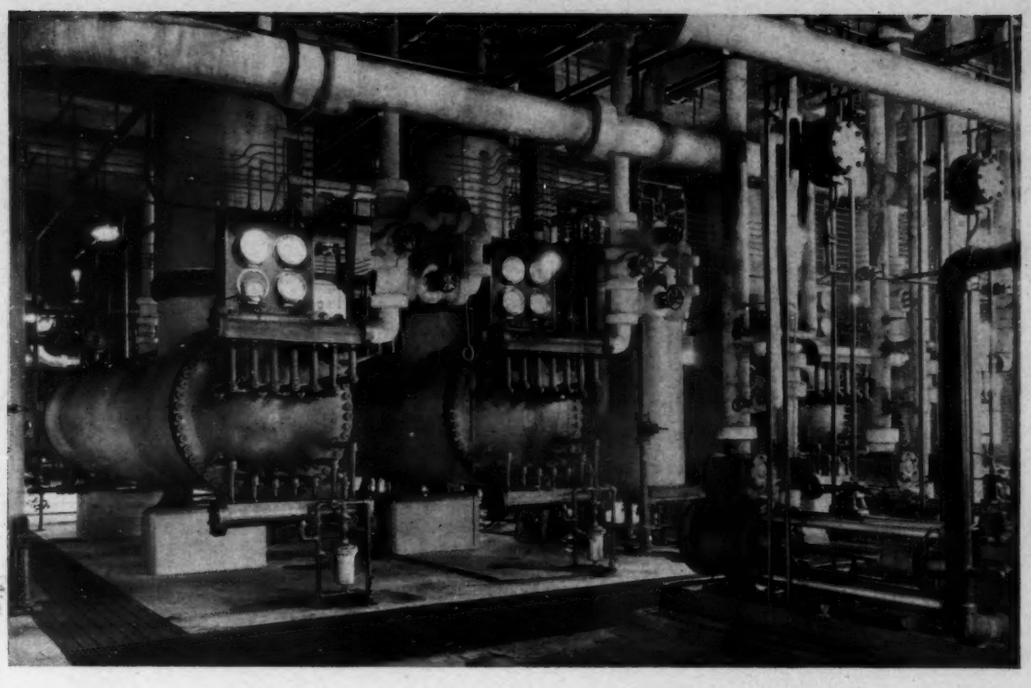


Centrifugal pumps are used in the light oil pump house with all units electric motor driven.

Sinclair New York

Interior of Filter plant where contact clay is removed from oils being processed. Below—Large steam driven duplex pumps used in charging oil to the system.

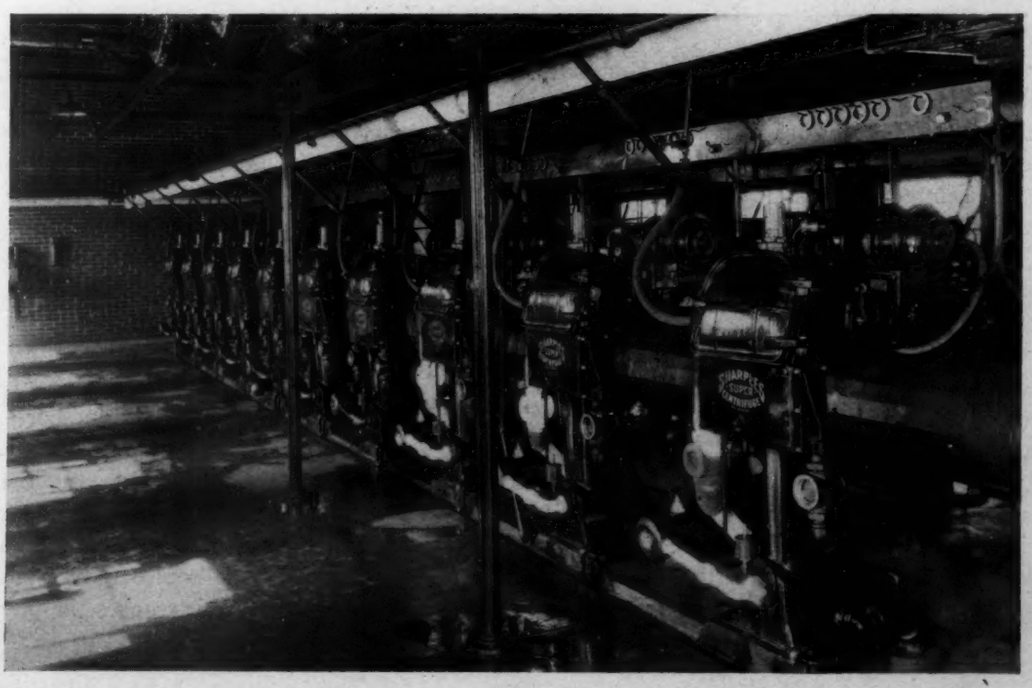


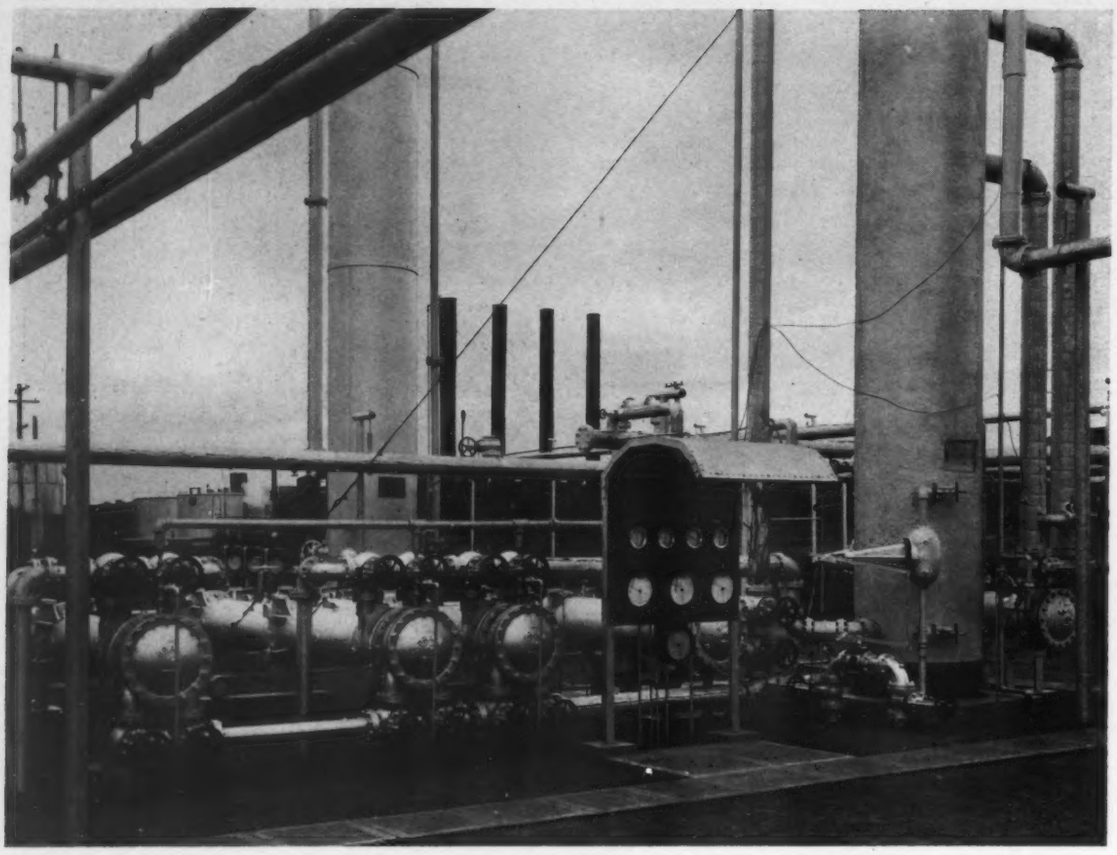


To secure oil temperatures of minus 60 deg. Fah. a total of 900 tons refrigeration capacity is required.

Wellsville, Refinery

Light oil treating plant for chemical trea ment of gasoline. naphthas and Kerosene. Below—A portion of the centrifugal dewaxing plant. 40 such machines are installed.





All heat exchangers are equipped with by-pass valves in Pacific Western Oil Company's absorption plant at Elwood, California.

Turbine Drive With Low Pressure Gas

By BRAD MILLS

THROUGH such innovations as the use of low pressure gas for driving turbines and successful use of ocean water for plant cooling, Pacific Western Oil Company has made its Elwood absorption plant conform to a plan best adapted to local field conditions. The advantage of topography was also capitalized, as reflected by the arrangement of the plant layout, while a satisfactory well pressure has obviated the necessity for compressors.

The plant includes twin distillation units which may be maintained and operated as distinctly separate units. The first was built with the view of adding at least one other, and such an addition was accomplished without a shutdown. The emergency and auxiliary equipment incidental to operation of the first unit was made the common standby for both units, thus illustrating the value of careful planning before the first unit of a plant of undetermined capacity is built. Subsequent additions closely paralleled provisions outlined in the beginning and the expansion from a one-unit plant to a twin unit installation accompanied the increased gas production with a minimum effort and expense.

Field conditions at Elwood are in some respects almost perfect for the operation of a low pressure absorption plant; but there are also obstacles which are not found in the average California district. The field pressure and action of the wells simplify plant operation, but the scarcity of fresh water and corresponding shortage of steam offer a full share of problems. The oil is a high gravity product, but the gas shows a lower gasoline content than that produced in many fields yielding a much heavier crude. The semi-treating of the crude from most of the wells also reduces the gasoline content of the gas before it reaches the plant. One against

the other, the advantages are about offset by natural disadvantages. Through meeting these handicaps, the plant has achieved an individual flexibility not found in plants of several years ago.

The flow chart of the plant does not differ radically from that used in latest type installations, but several innovations have been introduced which remove the slightest possibility of a monotonous tracing of the gas, oil and water through the plant. The standardization of gasoline plants has made the method of handling the products and the nature of the equipment more interesting than a mere tracing of the various flows from one point to another.

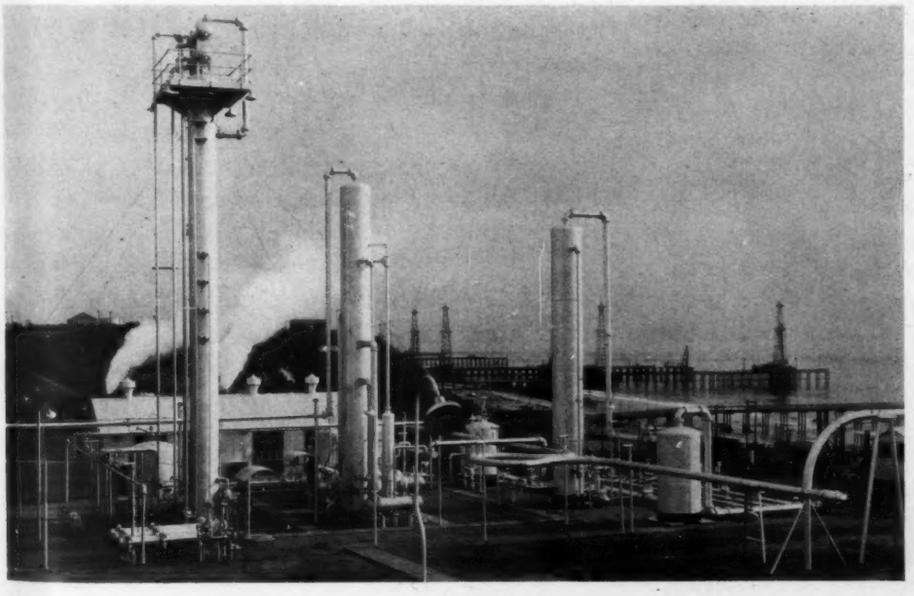
TURBINE OPERATION

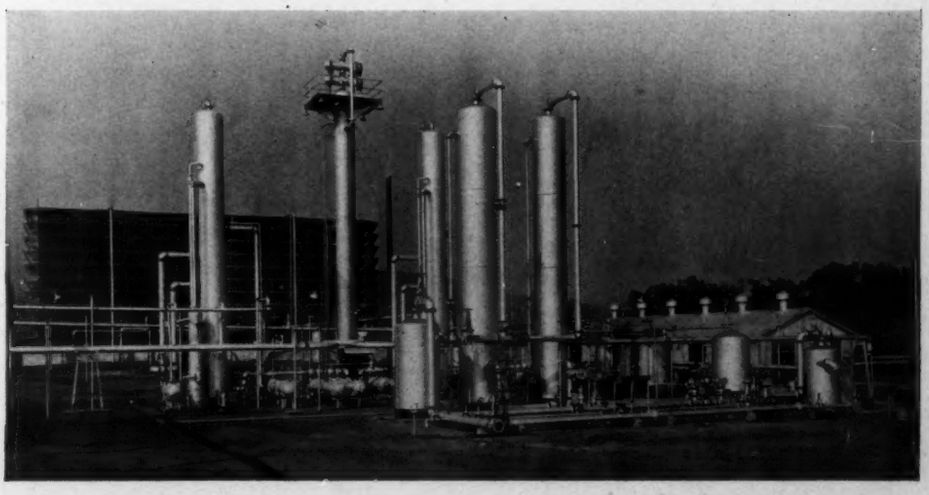
The use of low pressure dry gas for operating the main turbines has been very successful. Gas is being used for this purpose in many other plants, but perhaps under much greater pressures. The three large turbines were originally designed to operate on steam, but an abundance of low pressure dry gas started experiments which led to the present arrangement.

With a plant steam pressure of 145 pounds, it was obvious that adjustments would have to be made to adapt the turbines to a gas pressure of only 45 pounds. By enlarging and adding to the steam nozzles, a capacity great enough to run the turbines at a speed of 2400 revolutions per minute was obtained. Since the manifold line pressure represented a form of stored energy which might not otherwise be used, the dry gas was used at a distinct saving over steam.

To eliminate any tendency of the gas to freeze at discharge, it is heated to 190° before going to the remodeled turbines. Exhaust steam is used exclusively for this purpose. Since live steam contains more energy than a similar volume of dry gas, it is readily evident that a much greater capacity had to be provided for the turbines to develop the required speed and power. Thus both the handicap of a very low pressure and the necessity for a much greater volume with a less energetic agent was successfully overcome.

The rich oil, lean oil, spray water and reflux pumps are all mounted on a common shaft and operated by the gas-driven turbines previously described. Three complete series are maintained, one for each distillation





Above—Original construction of Pacific Western Oil Company's Elwood absorption plant was such that another unit could be added without a shut-down, and

Below—the plant as it now appears with two distillation units.

unit and one as a spare. Such an arrangement necessitates the use of centrifugal pumps. The uniform speed of the four pumps works to advantage in turning out both an even volume and uniform grade of gasoline with a fairly constant intake. The common shaft arrangement also requires much less room than installations having small turbines for each of the circulating factors.

The cooling arrangement is also very interesting and seems to question the theory that salt water should not be used for such a purpose. Originally the cooling tower and incidental equipment were designed for use only with fresh water, and was used in this manner for some time. The unsteady supply of fresh water, however, was the direct cause of casting longing eyes at the Pacific Ocean, which is only a stone's throw from the plant.

SALT WATER COOLING

By raising the concrete base of the cooling tower a full three feet and submerging the atmospheric cooling plates, the plant was changed to operate on salt water directly from the ocean. The change was a simple matter, and the original tower is still held in readiness for use with fresh water on short notice. During adjustments, fresh water is circulated over the tower, as originally done. Salt water leaving the tower overflows, passes through a steam condenser, in which all compressor and pump steam is condensed. The condensed water is used in the plant boilers.

To overcome any tendency toward electrolysis, zinc plates are used. About 600 pounds of these strips is used in the base of the cooling tower, while plates have also been placed in the condensers and stabilizing unit. The strips are one-half by six by 12 inches and have successfully checked any tendency of the salt water to attack the conventional fittings. The plant has been operating on salt water for about eight months and it has been necessary to change only one small nipple during this period.

Ocean water is brought to the plant with a deep well pump which is located on a well pier and a considerable distance from shore.

A small re-run still for cleaning absorption oil is maintained. It was largely designed by the company's engineers and is of a horizontal type. This still is also used for cleaning drip gasoline brought in from the field.

The plant was located to take advantage of topography. The cooling tower and principal absorption equipment are on the slope above the pump house. This eliminates pump pits and vapor pockets common to plants built on level ground. The arrangement gives uniform circulation of water and oil with minimum effort.

The gas is taken from the field traps at a pressure of 55 pounds, but reaches the plant at 50 pounds. It passes through scrubbers and goes to two absorbers, which are identical in design. The dry gas then flows through the discharge scrubber to the manifold system.

The manifold arrangement was designed to give the plant operator full control over the distribution of dry gas, and in addition practically enables him to spot lease or line trouble within the field. The manifold division includes blowoff, gas lift, lease fuel, boiler plant fuel, gas turbine and pressure lines for flowing wells. The abundance of dry gas has encouraged construction of a manifold arrangement which utilizes the maximum quantity through a flexible outlet system. The surplus gas represents a stored energy which is used in various ways.

Although the plant presents two distillation units, operation is identical. The rich oil from the absorbers passes to small tanks, to the centrifugal pumps and thence to the heat exchangers. It then goes to the preheaters before entering the still. The preheater in the still is placed at the second tray from the top stripping tray, instead of occupying a position in the bottom. This places the preheating where it does most good.

The oil passes from the still to the heat exchangers and on to the lean oil surge tank. It is then picked up by the lean oil pump and sent to the pressure exchanger. After passing through the cooling coils it is sent to the absorbers to begin another circuit through the plant. The lean oil to the absorbers is metered by orifice meters.

The top vapor temperature is controlled by reflux gasoline. The vapors are then sent through the cooling coils and reach the gasoline accumulators in a liquid form. The gasoline accumulator is the source of the reflux gasoline, the remainder going to the stabilizer feed tank. The stabilizer operates at a temperature of 265° kettle temperature and a pressure of 180 pounds.

A 12 x 6 x 12-inch, two-phase Ingersoll-Rand steam compressor is used for handling plant vapors, while a 12 x 12 x 12-inch compressor of the same type is used for field vapors. Both are automatically controlled by regulators on the steam line.

The normal oil circulation is 135,000 gallons per day, but as much as 200,000 gallons has been circulated successfully. During field test periods, as much as 17,000,000 cubic feet of gas has been treated, but the normal capacity of the plant is considerably under this figure.

A compressor station is under construction, but it will be used primarily for gas lift operations. Through the application of gas pressure to the producing wells, plant compressors probably can be avoided for some time.

Most of the oil is being cooled as it is produced. This raises the gravity of the crude, but in turn chills some of the natural gas into the oil and lowers the gasoline content of the gas reaching the plant.

The plant, which was designed and built by C. F. Braun and Company, has a rated capacity of 9,000,000 cubic feet daily, but is now treating about 11,000,000 cubic feet. The average recovery per thousand cubic feet of gas treated is 1.11 gallons.

Soviet Construction Plans Indicate Policy Change

By ROY E. LEIGH
Associate Editor of THE OIL WEEKLY

A STUDY of the Soviet construction program, which is of such magnitude as, for example, might be required if the entire oil industry of the Mid-Continent area were to be re-built or duplicated in a short five-year period, reveals indications and evidence of an important change in Soviet policy. The writer is convinced that, so far, the greater percentage of Russian oil has been sent to export. The local populace is denied the use of petroleum. However, large pipe line and refining projects now being planned will not be used or needed unless one or another of the features of this present policy is to be changed. Pipe line and refining facilities which will have their outlets at Moscow, Artemovsk, and other interior railway points can be used only in event the ban on domestic consumption is to be raised or if petroleum products are to be shipped by rail to European and Asiatic markets.

Since Russia has now become the second greatest oil producing country in the world, and since Soviet authorities have announced further increases in production which are expected to be achieved concurrently with the construction of large transportation and refining facilities, it becomes interesting to speculate regarding the future policy of the leaders of the socialized oil industry.

S. M. Ganshin, formerly a vice-president of the Azneft Oil Trust but now referred to as if speaking for Soyusneft or for the Soviet oil industry as a whole, is quoted in a recent Associated Press dispatch from Moscow as having stated that Russian production totaled 18,651,000 metric tons (or approximately 134,827,000 barrels) during the 12 months ending December 6, 1930, and as having predicted that production would show a further increase of 45 per cent or a total of about 195,000,000 barrels during 1931.

Of greater interest, however, is Mr. Ganshin's prediction that Soviet oil production is again to be increased by 90 per cent, or nearly doubled, during the remaining half of the five-year period. If this goal is achieved, Russian production will exceed 700,000 barrels per day during 1933, which means that outlets will have to be found for an increase of more than 121,000,000 barrels of oil per annum. That these figures are not impossible of achievement is indicated by the marvelous fertility of Russian oil fields and by the fact that the Soviet oil industry has heretofore attained every goal set for it since the commencement of the five-year plan of industrial expansion.

ROY E. LEIGH

Mr. Leigh recently was in Russia while making a world survey of oil conditions as Special Foreign Representative of the Gulf Publishing Company publications. The accompanying discussion of plans of the Soviet oil trusts is of interest and importance at this time because of Russia's influence in world markets, both now and when the five-year plan has been completed. Any discussion at this time leaves much for speculation, but it is pointed out here that plans now being laid involve the handling of large quantities of oil to strategic points in the world market. Also the facilities are being arranged to provide distribution to Russia's home market which is now being deprived of all supplies because of the forced exports to secure funds for the five-year plan.

Are these increasing floods of oil to be dumped in foreign markets or consumed in domestic operations?

Heretofore, about 97 per cent of the energy of the socialized oil industry has been directed toward export trade. Domestic demands, apart from the fuel requirements of the railways and state industries, have been ignored. Individual citizens are denied the use of automobiles and are unable to purchase gasoline or other petroleum products. As a matter of fact, it is only those oil fields whose output can be sold in foreign countries that have been developed to any extent. Interior fields located remote from tidewater whose output is allocated to domestic requirements remain dormant and virtually undeveloped.

Operations in all of those fields for which ocean outlets are provided have been pushed to the limit of the Soviets' resources, and it is from these flush fields that Russia's increases have come. Russia's greatest oil centers are at Baku and Grozny, on and near the Caspian

Sea, and at Maikop, a short distance inland from the northeastern shore of the Black Sea. Oil fields in these three districts are served by two trunk line systems paralleling the Caucasus Mountains and stretching from the Caspian to the Black Sea, whence tankers have outlet via the Mediterranean to European markets and through the Suez Canal to Asiatic ports.

BUILD EXPORT FACILITIES

Construction projects now under consideration contemplate the substantial increase of all these export facilities,—and more significantly,—include several pipe line projects and refining centers which will serve the interior and Asiatic regions. These include a 2000-mile pipe line along the Volga from the oil producing regions to Moscow and other industrial centers, large refining bases at Moscow and other interior railway points, and 750 miles of line to convey refined products from Grozny to important industrial and railway centers in the eastern Ukraine.

These new projects all have their termini on important trunk railway lines connecting with the Trans-Siberian Railway. Does this mean that the ban on the domestic consumption of oil may be lifted and that petroleum products may be supplied to the Russian populace, say, after the termination of the five-year period? Or does it mean that refined products will be shipped over the Trans-Siberian route to Chinese and other eastern markets? Do the Soviets anticipate the loss of distribution through American companies interested in the opening up of the competing oil fields in Iraq, or do they intend to cut loose and enter the Asiatic markets on their own behalf?

Heretofore, practically all of Russia's oil exports have been shipped by tankers across the Black and Mediterranean seas, through the Straight of Gibraltar and the Suez Canal; but completion of internal pipe line projects now being planned will make it possible to move oil by rail westward to Europe and eastward to China and Japan. This is just such a move as the Soviets, having no merchant marine, might be expected to make if they were planning to enter the continental European and Asiatic markets on their own behalf. Heretofore, the activities of Russian Oil Products, Ltd., and the Soviet Naphtha Syndicate have been limited to the United Kingdom, Mediterranean, and western European markets.

Distribution of Russian oils in the Asiatic and African markets has been handled by Standard Oil Company of New York and Vacuum Oil Company. If/when the Standard-Vacuum merger is approved by the Supreme Court, and if/when the Iraq pipe line is built, these companies—who share in the Iraq oil consortium —will no longer be dependent upon the Soviets for the supply of oil to their European, African, and Asiatic markets. Do the Soviets expect these American companies then to cut loose from their Russian affiliations; or do they intend to divorce themselves from their capitalist allies as a feature of their plan to conquer world trade?

HOLD WORLD AT MERCY

Soviet authorities, recalling how they were able to force Standard Oil Company of New Jersey, the Royal Dutch-Shell, and Anglo-Persian Oil Company to enter a truce with Russian Oil Products, Ltd., in the British markets, make no secret of their belief that they hold oil producers and refiners of other countries at their mercy; and one must confess that, within certain limits and assuming the success of the five-year plan, they actually do. Their insurmountable advantage lies in their control of disciplined and virtually unpaid slave labor. So long as capitalist companies must pay their employees in gold or sound money at wage rates which permit the maintenance of European and American standards of living, the Soviets who pay their workmen in paper money and allow them only the barest essentials necessary to sustain life will be able to sell petroleum products at cut-rate prices.

In the official statement above referred to, Mr. Ganshin admitted that heretofore the increase of Soviet oil sent to export regularly exceeded in proportion the increase of internal consumption but pointed out that the increase in internal consumption was allowed to keep pace with the increase in exports during 1930, both having advanced by about 25 per cent. This carefully worded statement refers to the rate of increase and not to the volume of oil consumed internally as compared to the enormous quantities of oil which have been sold abroad.

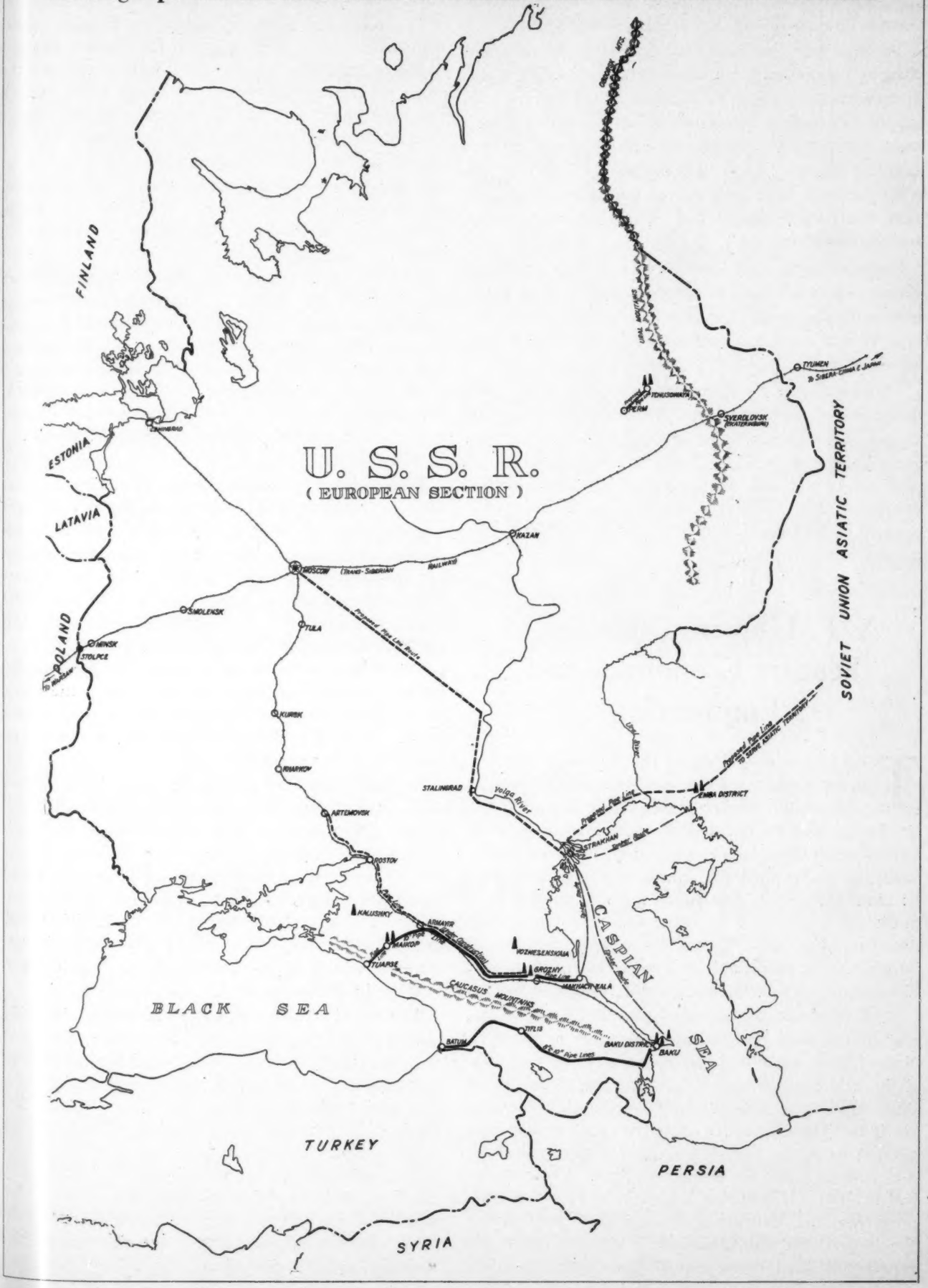
The writer of this article has seen statistics purporting to show that a large percentage of Russian production is consumed within the country; but, after having traveled extensively in the Soviet Union and having noted the scarcity of automotive equipment, the almost complete lack of roads and highways, and the degraded living conditions of the people, he is compelled to reject them. Gasoline is not available to private individuals.

Russian production figures have been called into question repeatedly. Sir Henri Deterding, for example, said to the writer that "If the truth were told, I would not be surprised to learn that Russian production is only about 60 per cent of that currently reported." If there is any disparity in Soviet figures, it probably occurs in those alleged to represent domestic consumption.

But 60 per cent of 135 million barrels represents a large volume of oil.

Mr. Ganshin said recently that Russian exports will continue to increase in volume but will decrease in percentage with respect to total production. He referred to the scheduled increases in production already mentioned, to a large increase in drilling, to extensive refining facilities now being built at Batoum, Tuapse, Saratov, Armavir, Khabarovsk, and Kohanda, and said that "we not only are increasing storage and tank vessels but propose to build new pipe lines." He stated that construction has already been commenced on a

MAP OF RUSSIA IN EUROPE
Showing Pipe Line and Rail Outlets for Russian Crude and Refined Oil Production



pipe line connecting the Grozny field with the Ukraine.

It may happen that the Soviet ban on domestic consumption of petroleum will be lifted or modified, but there is little possibility that exports will decrease.

The five-year plan contemplates that Russia will become self-supporting in machinery and all other types of manufactured goods. American manufacturers and supply men will be interested in Mr. Ganshin's statement that "We are taking measures to speed up and raise the efficiency of drilling machines. This year we will receive a large part of the necessary equipment from our own industries and be less dependent upon foreign manufacturers."

Refining plants built from Russian designs and from Russian materials have not proved completely satisfactory, with the result that present construction of this type of equipment has been entrusted to American engineering firms.

This expansion program is of interest to every producer, refiner, and distributor in the world, as it could happen that this flood of oil which may be dumped into glutted markets by a socialized industry unconcerned with production and operating costs would thwart all restrictive and regulatory measures now being attempted in the United States, South America, and other oil producing countries.

A. P. I. Spring Meeting to Feature Economics and Engineering

TWO of the sessions of the mid-year meeting of the American Petroleum Institute's Division of Refining, Statler Hotel, April 15 and 16, at St. Louis, will be devoted to the presentation of papers and discussions dealing with the progress of investigators toward the solution of such problems as standard testing procedure for determination of antiknock values and the vapor lock problem as they concern motor fuels. The remaining two sessions will be given over to committee reports and round table discussion of the economics of the refining industry.

R. C. Holmes, president of The Texas Company, and chairman of the general committee of the division of Refining and the committee on refinery statistics and economics will have charge of the round table discussion scheduled for Wednesday evening, April 15. The economics committee will at that time present its report covering estimated supply and demand for gasoline for the period April 1, to September 30, 1931. In addition it is proposed to have a report from the Petroleum Economics Committee of the Federal Oil Conservation Board, similar to the report published at the annual meeting of the Institute last November at Chicago. This will give the refining branch of the industry the benefit of two independent surveys.

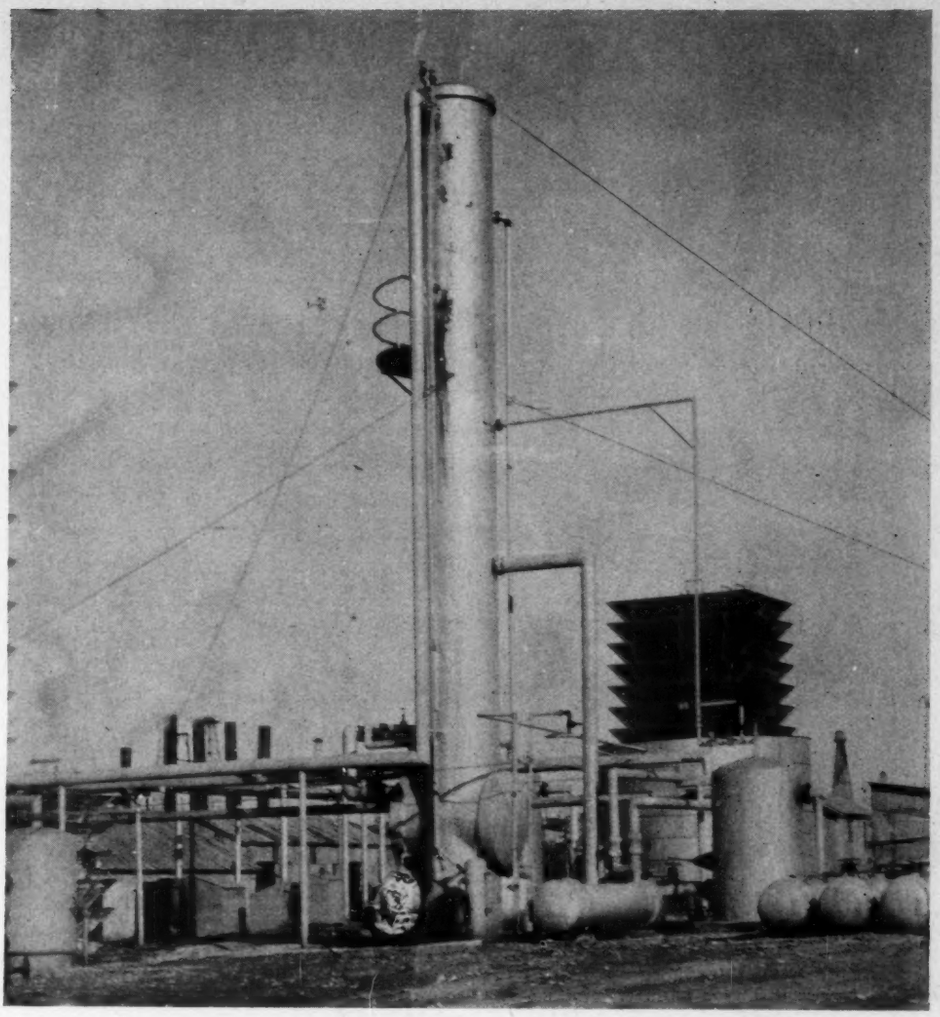
The mid-year meeting opens Wednesday afternoon, April 15, at 2 p. m., with the session devoted to motor fuel. The program will largely concern the work on testing fuels formanti-knock value and on the vapor lock problem done at the United States Bureau of Standards under the auspices of the Cooperative Fuel Research Committee. Definite progress has been made toward agreement upon a standard method of determining gasoline anti-knock values and there will be full discussion of this subject.

Dr. H. C. Dickinson of the United States Bureau of Standards will present a paper on "Progress Toward a Standard Method for Determining the Anti-Knock Value of Motor Fuels." O. C. Bridgeman, also of the Bureau of Standards will discuss "Automotive Fuel Line Temperatures." K. G. Mackenzie, The Texas Company, as chairman, will present the report of the Committee on Testing Methods and Specifications.

Technical sessions will resume Thursday morning which will be of special interest to refinery engineers. The morning meeting will be devoted to study and discussion of alloy steels for high temperatures and of condenser corrosion, while manuals on refinery fire protection and waste disposal will be considered in the afternoon. H. D. Newell, Babcock & Wilcox Company, will speak on "Alloy Steel for High Temperature Service." Walter Samans, The Atlantic Refining Company, as chairman, will present the report of the Committee on Corrosion of Refinery Equipment. A speaker to be selected will discuss "Corrosion in Condensers."

At the afternoon session round table discussion will again be featured. Tentative drafts of the proposed API Manual on Fire Prevention in Refineries and the API Manual on Disposal of Refinery Wastes, will be reviewed. The discussion will place emphasis on a tentative draft of Part 2 of the API Manual covering waste gases and vapors. C. W. Smith, Standard Oil Company (Indiana), as chairman will present the report of the Committee on Accident Prevention in Refineries.

The board of directors of the Institute will hold a dinner meeting on Thursday at the close of the mid-year meeting. The Division of Refining General Committee, the Committee on Refinery Statistics and Economics will hold meetings during the two days session. In addition the following committees will meet at hours to be selected: Accident Prevention in Refineries, Corrosion of Refinery Equipment; Disposal of Refinery Wastes, Fire Prevention in Refineries, Refinery Technology, Standardization of Refinery Equipment, and the committee on Testing Methods and Specifications.

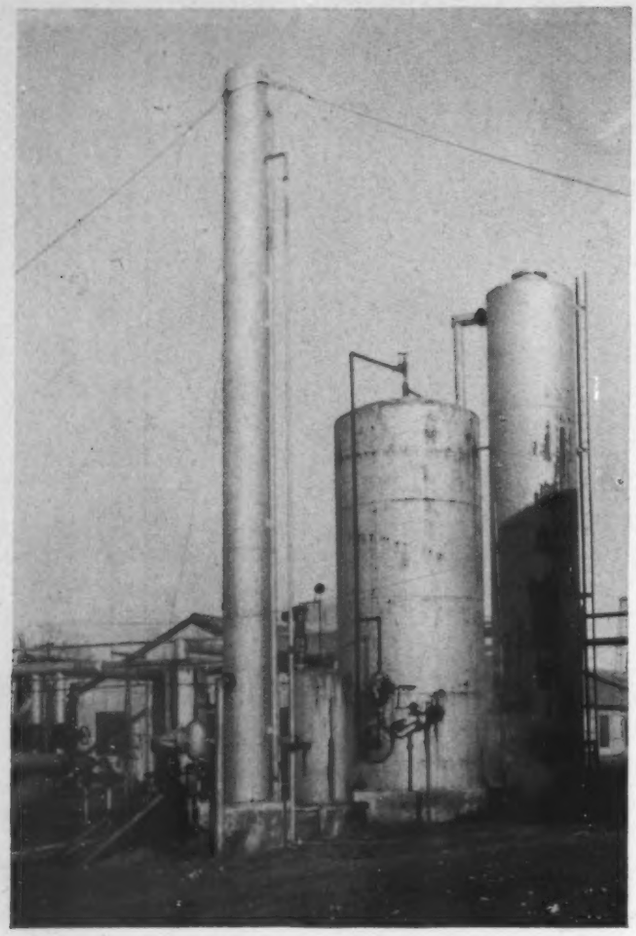


Close-Cut Absorption Oil Used By K. P. Gasoline Company

IN August, 1930, the K. P. Gasoline Company began operating its absorption gasoline plant in the Earlsboro Townsite pool. The engine room, powered by four 200 horsepower Clark Super Two's, furnished the means for flowing several wells in the west side of the town of Earlsboro. The low cylinders, 18 x 20 inches, pull the gas from the traps at the wells through a scrubber at the plant entrance, where several barrels of oil are salvaged each day.

Boosting the gas from 10 inches on the intake to 40 pounds discharge, it is directed to the louvre tower, cooled in Griscomb Russel Bentube sections then to a Petroleum Engineering, Inc., absorber. Re-entering the engine room after passing through the absorber the gas is boosted to 200 pounds for gas-lift operation. From an entry content of two gallons per thousand cubic feet, the gas leaves the 9 x 20 cylinders stripped to a condition that a standard physical test reveals no gasoline left in the residue gas.

The oil, both rich and lean, as well as the reflux gasoline, is handled by Worthington steam turbine driven pumps, all on the same shaft. The rich and lean pumps are three-inch, and the reflux pump is two-inch discharge. The oil is directed through G-R atmospheric



Showing K. P. Gasoline Company's plant with reabsorber, absorber and accumulator tank.

coolers and enters the absorber, leaving through a Neilan float controlled valve to the fat tank, where the level is maintained by a Neilan remote controlled valve. When the oil reaches a predetermined lower level, the float sets in motion air pressure which, acting on the diaphragm of the remote valve in the discharge of the pump, shuts off on the discharge enough to slow down the volume handled and keep the oil level at a constant point in the fat oil tank.

From the rich oil pump the fat oil is directed through three sections of heat exchangers to a vent tank, then through a preheater to the Petroleum Engineering stabilizing-dephlegmating still. The vapors from the vent tank between the heat exchangers and the preheater enter this still also.

The vapors from the still enter G-R primary condensers where the temperature is maintained at a point where only a part of the gasoline is condensed, to be used as reflux over the still, pumped through the two-inch Worthington centrifugal pump on the shaft with the rich and lean oil pumps. Passing through, the uncondensed vapors enter another battery of condensers where condensation is completed. The dephlegmator top is carried at 235°F., and at this temperature, the finished gasoline averages 340°F. end point.

All entrained vapors emanating from the accumulator tank, and those from the storage tanks are carried to a reabsorber. The oil from the lean pump of the major system stream is split to allow a part of it to travel to this reabsorber, where it comes in contact with all these vapors from the various parts of the system. The oil from the reabsorber is handled by a Worthington 4½ x 2¾ x 6 simplex steam pump throttle governed by a Neilan kidney float connected to a steam controller in the line to the steam chest of the pump. This pump installation is made necessary because the pressure on the reabsorber can only be as high as the lowest pressure on any one of the tanks of the system, whether it is a vent tank, fat oil tank or storage.

Leaving the discharge of this pump, the oil is directed to the fat oil tank of the major system and flows with it through the distillation unit of the plant. An average of 4,500,000 cubic feet is handled each day with a production of around 9000 gallons of grade BB gasoline, with an average gravity of 88.9 and an end point of 360.

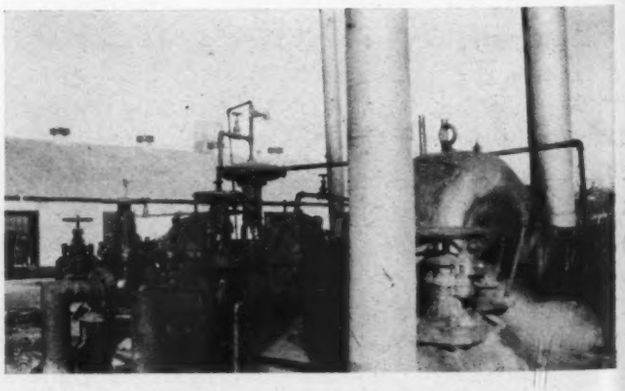
One interesting part of the operation of this plant, is the characteristics of the absorption oil used. Following is a distillation report of a car recently received by the K. P. plant from the Deep Rock Refineries.

ABSORPTION OIL

45.8° A. P. I. Gravity.

Per Cent Over	Temperature
I.B.P.	340
20	368
40	372
50	380
70	388
80	400
E.P.	426
Recovery	99.6%
Residue	.4

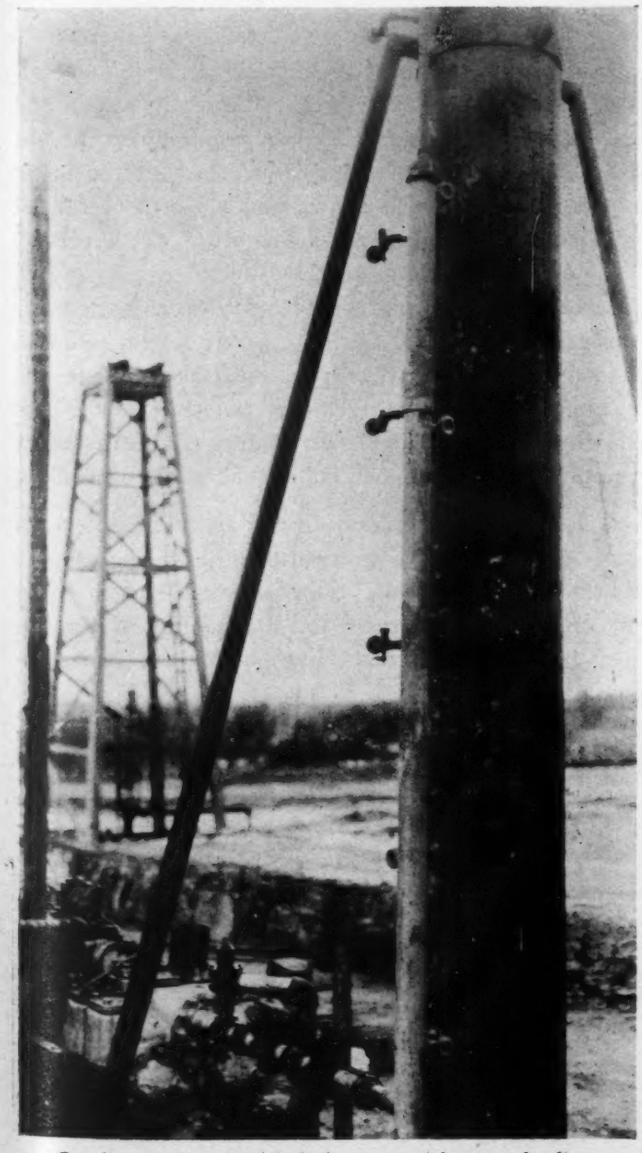
No greater loss in absorption oil is reported by the use of this low initial, low end point oil, than is usually found through the use of the higher boiling oil used at the average plant.



Turbine driven pumps in the K. P. Gasoline plant yard handling oil and reflux gasoline.

Control Features Konawa Plant

CROSBIE & Moran, in constructing their Number 4 absorption natural gasoline plant in the Konawa field, have built into it features not usually found in plants of this nature. The main engine room contains six Type X Cooper-Bessemer twins and two Clark Super "2's." Six of the Bessemers have 16 x 20-inch compressor cylinders, and the other four have 17 x 20-inch. The Clarks have 18 x 20-inch cylinders. All of them are handling an average of 8,000,000 cubic feet of gas daily.



Gasoline loading line leak detector, with steam loading pump in back-ground.

This engine room serves the field immediately surrounding the plant proper, while in that part of the field a little farther away to the south, there is a booster plant with two Type X twin Cooper-Bessemers. The gas handled by the booster is discharged into the gathering lines of the main plant, which is delivered with the main stream to two Tulsa type absorbers.

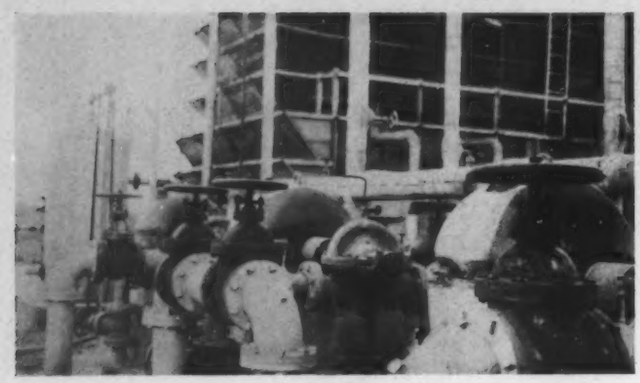
With 35 pounds on the residue line from the absorbers, pressure is maintained within very narrow fluctuations by a Tycos pressure controller, actuating an eight-inch Jenkins Diaphragm control valve. The gas is taken up beyond this control by four Clark 200 horsepower double-acting engines in the 16 x 20-inch cylinders, passing from this stage through coolers to the 9½ x 20-inch cylinders and is delivered into the main line of the Southwest Gas Company for distribution for domestic and industrial fuel.

The absorption oil is handled by Worthington centrifugal pumps driven by Terry steam turbines. Water difficulties attributed to salt water contamination caused the company to install Griscomb-Russell atmospheric coolers in the oil and gas circuits. The water is handled over the cooling tower by two Terry turbine driven Worthington centrifugal pumps, with Tracyfiers on the steam line entering the turbine governor valve. A third pump is always ready for service, setting idle as a standby until circumstances justify shutting down either one of the other pumps in operation.

The gasoline, a production of about 10,000 gallons daily, is stabilized in a Tulsa Type tower, pumped to it with a Dean Brothers 6 x 3¾ x 12-inch simplex pump. The speed of the pump is controlled with a Mason pump governor. From the stabilizer, the gasoline is passed through a continuous chloride of lime treating plant. It is loaded through a 10 x 3½ x 10-inch Gardner Duplex steam pump with a Crosby relief valve on the discharge line near the pump.

THIEF DETECTOR

Connected to the loading line is one of the features being installed in the other plants of the company. This apparatus is what Superintendent L. D. Hare calls his "Thief Detector." It is built from a piece of 12-inch



Steam turbine driven centrifugal pumps on water circulation. Crosbie & Moran Gasoline Plant, Konawa, Oklahoma.

pipe, with heads welded in each end. It is placed vertically on a concrete foundation and is prevented from falling by being braced with two-inch supports welded to a clamp fastened around the apparatus. This "Thief Detector" is a sort of a volume tank. The gasoline which is pumped to the rack does not pass through it, but is allowed to flow into it under the pressure maintained on the line during loading periods. It is allowed to remain in full connection with the loading line at all times.

Gauge glass connections are placed on the side of it to indicate the level of the liquid. A recording pressure gauge is connected to the apparatus, and the stillman is required to make a reading of the pressure at stated intervals. The pressure is recorded continuously, and will naturally fluctuate according to weather conditions. But, if and when the line is tapped or a break occurs, the pressure shows a sharp break; alarm is given to the line walkers who search for the illegal connection or the rupture in the line.

It has already served in its intended capacity, for the superintendent said that the line had been tampered with twice, and that the stillman had discovered the sharp break in recording pressure within a few minutes of its happening.

AUXILIARIES

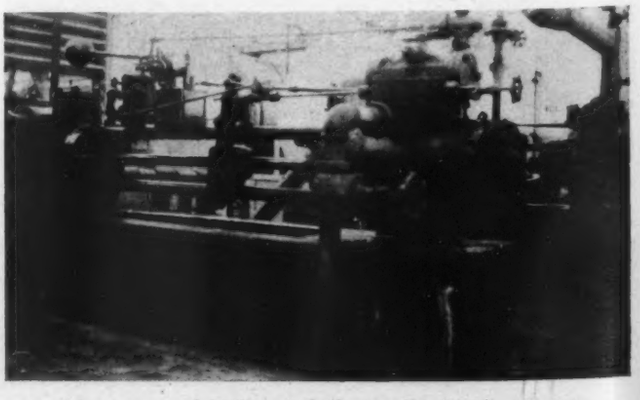
Air is furnished the supply tanks by a New York Air Brake compound stem driven compressor, keeping the required pressure on the storage tanks in the engine room. An automatic valve is placed on the control lines, and when the pressure drops below the predetermined point, the steam valve is opened, the pump started, and air is pumped until the pressure is up to the amount required. Then the valve is closed and the machine is stopped.

Electricity is generated by a G-E 28 KW Terry Turbine driven generator. Electricity is furnished with this installation for plant light and for service in the employes houses. An ice machine is built in the generator room, and enough ice is manufactured each day to supply the wants of the employes and that necessary in the laboratory and around the plant. This plant is home made, including the brine tank, the ice cans and the coils. Gasoline is piped from the reflux condenser accumulator to the coils in the tank, where it is expanded from about 150 pounds through a needle valve through the coils under plant vacuum. This sudden drop in pressure is sufficient to provide any desired temperature. Circulation of the brine is obtained by air agitation, and it is directed into the tank in such a manner that slow movement of the brine is maintained around the cans and coils. The controls are all manual, but when once adjusted and the ice cans filled with water, no further attention is given the plant until ice is pulled as needed.

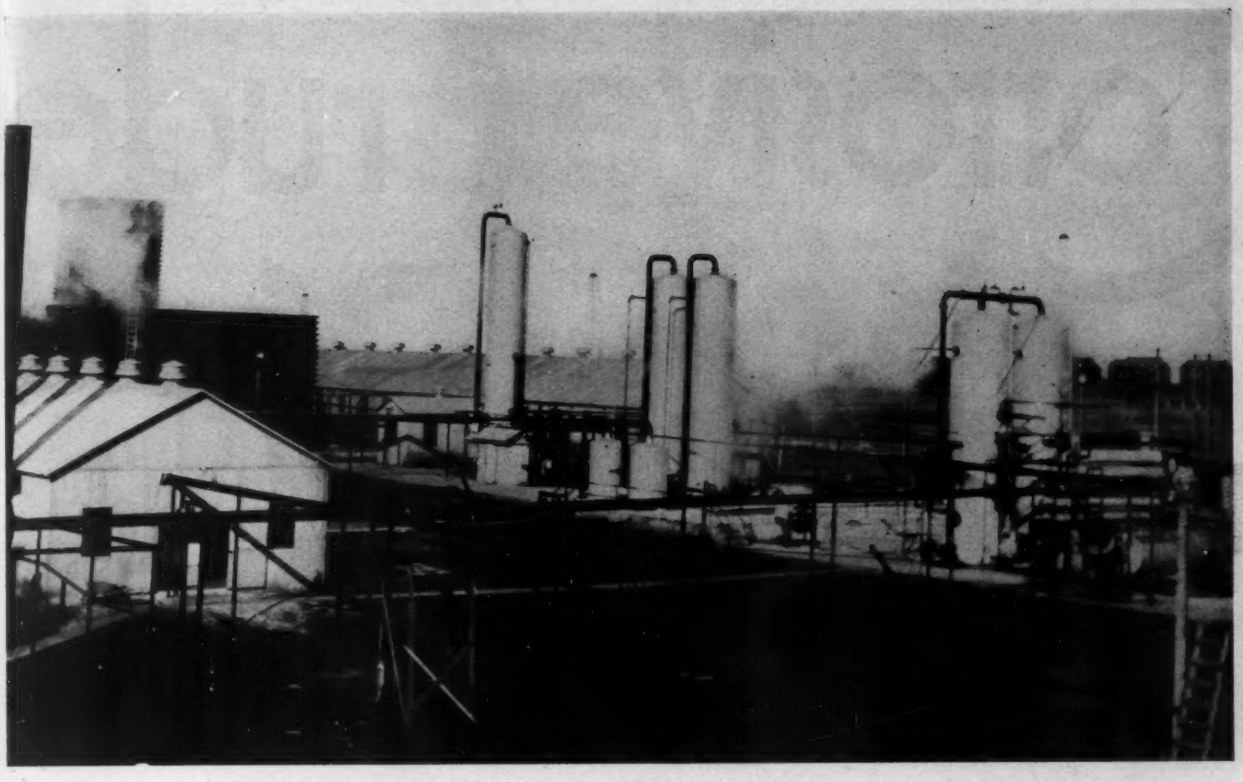
POWER PLANT

Another feature is the steam plant. Instead of the usual oil field type boiler, or the water tube type, Crosbie & Moran set three 125 horsepower, 150 pound working pressure Freeman marine type boilers. These boilers being round permit them to be easily loaded and transported. No foundation is required except the "legs" which rest on the concrete floor of the boiler room. The fire box is inside, with a Dutch oven lined with fire brick which takes the brunt of the flame. They are fired through the door of this oven through a pair of John Zink burners designed for fractionator vapors. Fuel to these burners is controlled by a steam actuated Tycos controller placed in the fuel line just inside the boiler room. Water is pumped into the boilers by two Worthington 10 x 6 x 12-inch simplex pumps, through Campbell boiler feed water controllers.

Crosbie & Moran have instituted an inter-plant safety contest, each plant vying with the other trying to make a record for themselves. Superintendent Hare has won the engrossed certificates for the months of August, September, October and November, 1930, in succession.



Steam pump handling gasoline to the fractionator at Crosbie & Moran's gasoline plant at Konawa.



General view of gasoline plant and crude oil stabilization plant operating on same plant site. Crude oil unit is shown at the right of the picture.

Lower Costs at Modern Gasoline Plant

THE economic structure of the oil industry as a whole, and that of the natural gasoline business in particular, is demanding more and more efficiency at all times in every phase of operation. There are nearly always ways and means, in a modern plant well built and economically operated, whereby the cost of operations may be reduced, yet not affecting the grade and quantity of gasoline manufactured. Automatic controls placed in strategically located positions in the line of flow of gas, oil, water, steam and gasoline, will permit operating with fewer operators, than where the control is manual, and the human element is more or less eliminated. Of course no manufacturer desires to build or operate a plant or factory wherein everything is handled and controlled by a robot.

Recently, Indian Territory Illuminating Oil Company built its Button natural gasoline plant, located in the SW SW Section 19-11-2, Oklahoma City pool, and has incorporated into the design of this plant, several features, all of which tend to reduce the operating overhead.

In the first place, all of the company's gasoline plants in this field are tied into a common gathering system, in order that each plant may take and process as much and no more gas than the capacity for processing. Otherwise one district might have a surplus of raw material and be forced to vent a large portion of the gas to the air, while another plant may be running on a short load, or shut down altogether for the lack of sufficient gas with which to operate.

Under the present proration agreement wells have a stated time wherein they are allowed to flow, and a stated length of time in which to make their production. During the flowing period, they are opened wide—all of the enormous rock pressure utilized to produce as much oil and gas as is physically possible in the limited length

Corrosive Crudes

SMITHLined Coking Drum
8 ft. x 38 ft.
for Standard Oil Company
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can now be refined in Corrosion-Proof Vessels by the latest development of the A. O. Smith Corporation, Oil and Gas Field Products Division . . .

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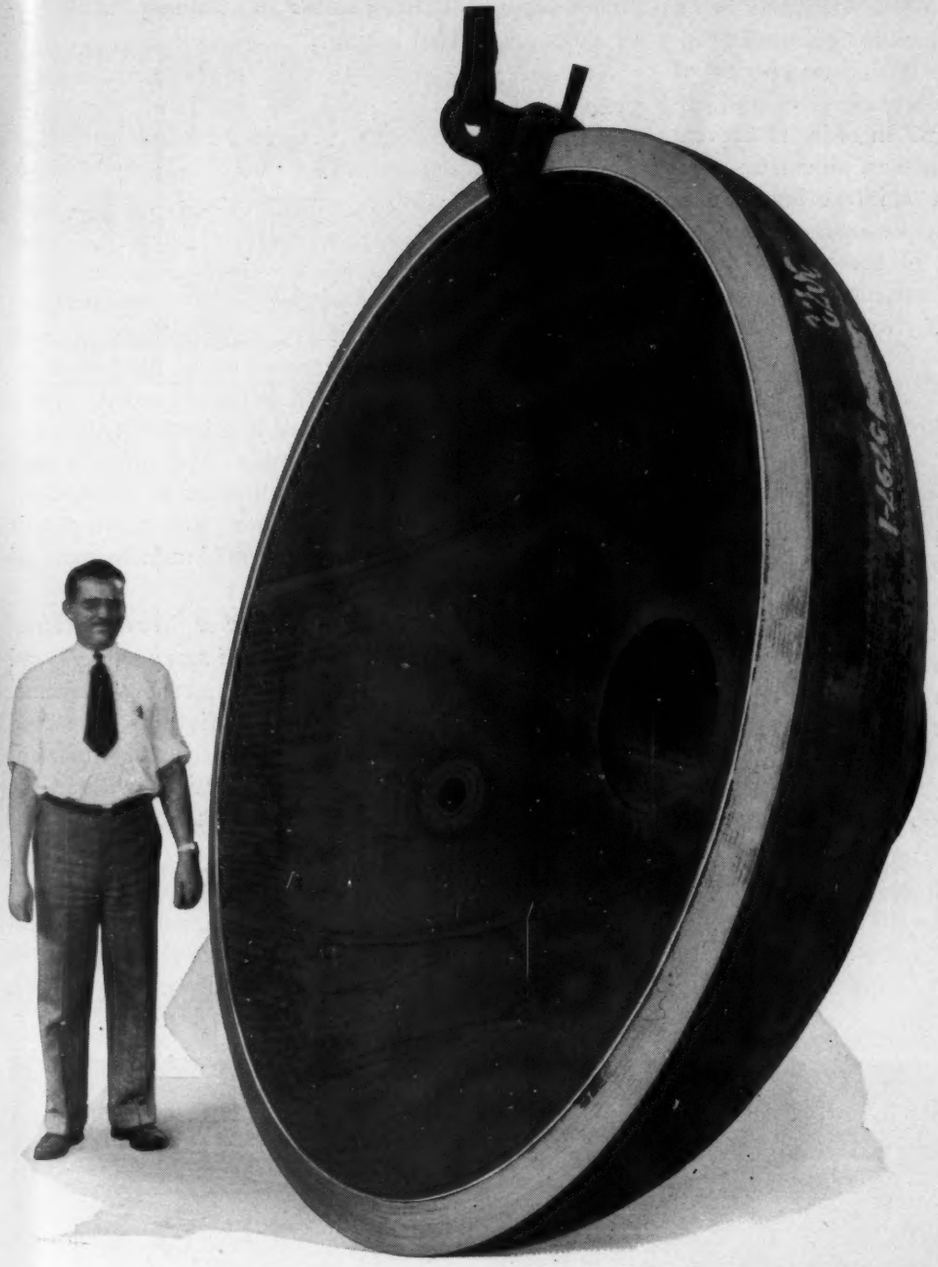


SMITHLined Head for Coking Drum—Standard Oil Company of Indiana

CORROSION-PROOF

SMITHLined Pressure Vessels

Completely lined with Corrosion-Proof Metal throughout, including heads, nozzles, manways and all openings. Full information on request.

SMITHLINED

of time available. Occasionally a few wells may be on production, at the same time, which are enormous producers of both gas and oil, and during this period of production, the capacity of the compressors and absorbers is taxed to the maximum. In order to prevent shut downs due to overloaded intakes, automatic regulators are placed in the vacuum or intake lines. These are built into the system on a by-pass arrangement, allowing only the proper amount of gas to flow to the compressors. The rest of this surplus, or fluctuating overload is allowed to flow directly to the absorbers.

OPERATING METHODS

The compressor room of this plant is equipped with 15, type 10, Bessemer gas engines with direct driven compressors. Part of these engines are equipped with 16-inch cylinders for the low pressure, or absorption work. These low pressure cylinders bring the gas in from the field lines and boost the pressure up to 45 pounds. They are equipped with conveniently located relief valves, which are set at a working pressure just above that of the compressors to enable the gas to escape back into the intake lines should the pressure at any time exceed that of the predetermined operating load.

Instead of the almost universally used steam radiators, which have been commonly made of two-inch pipe coils, this engine room is heated by several number 35 Venturafin air heaters and circulators. These air heaters contain an electric fan which keeps the air moving at all times, and prevents "cold spots" in the building. They provide a comfortable place to work, and there are no places for the engineer and oilers to "hang" over the radiators. More often than otherwise, in an engine room where there are the two-inch pipe radiators, and the low pressure cast ones for that matter, you will find a supply of wiping cloths and clothing out to dry, or fallen or stuffed behind them.

The water lines leading to the compressors and power cylinders for cooling purposes, fuel lines for power, and intake and discharge lines, are all laid in shallow conduits covered with grating, which makes all these lines accessible for maintenance and repair.

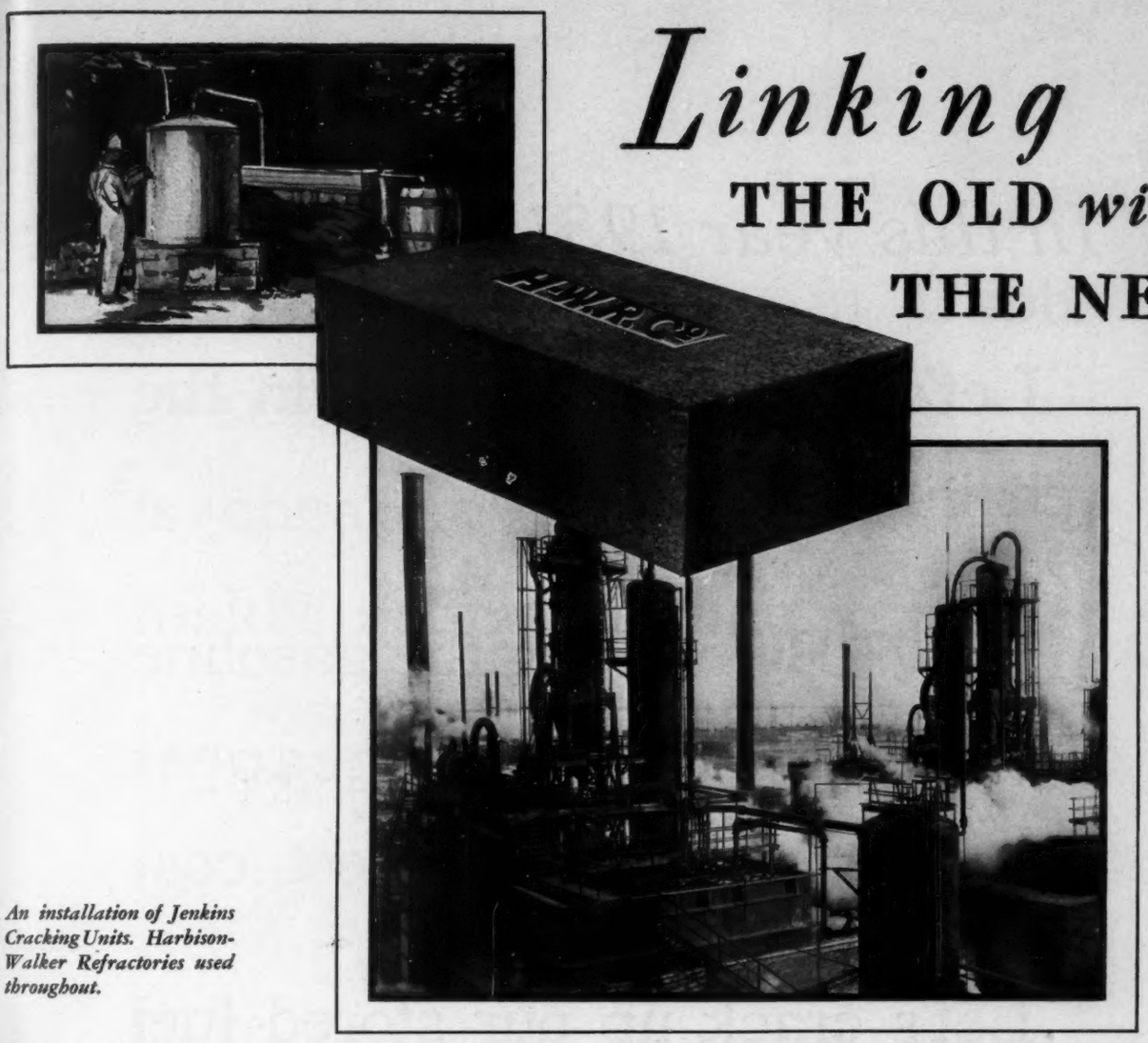
The gas from these low pressure cylinders is discharged into a common header which in turn delivers the gas through a scrubber tank, where the entrained lubricating oil and other heavy impurities, are allowed to drop out. From these scrubber tanks, the gas enters a battery of Griscomb-Russell Bentube sections of the atmospheric type coolers, placed in a tower of the company's own design and construction. This tower is built of common yellow pine, and is treated to prevent deterioration. It is built up in sections which will permit of salvage and removal with a minimum amount of labor and loss due to breakage.

Water is distributed over this tower through a number of Thompson "owl-head" type of spray nozzels, and falls in a misty spray directly onto the cooling elements. No lath decks or other distributing fixtures have been incorporated in the design of these towers. Sufficient operating temperatures have been attained without the additional expense of such installations.

OIL AND GAS SYSTEM

From these towers, the gas is passed through another scrubber where all condensate is removed. However, in this field the gas is low in gasoline content,

Seven 125 horsepower, 250 pound working pressure horizontal return tubular boilers comprise the power house providing steam for operation of the natural gasoline plant and crude oil stabilizing unit.



An installation of Jenkins Cracking Units. Harbison-Walker Refractories used throughout.

Linking THE OLD *with* THE NEW

EARLY in the history of the oil refining industry the builders of oil stills learned the economy of using dependable refractories. Builders of modern refining units, place confidence in Harbison-Walker products, knowing that this organization has kept pace with the growing demands of the refining industry.

Whatever the service conditions may be, there is a Harbison-Walker brick which will meet the requirements . . . Fireclay brick for the settings of cracking stills, shell and tube stills and of boilers: High-alumina brick for service where conditions are unusually severe: Refractory linings for roasters or rotary kilns used for reclaiming Fullers earth: Acid-proof brick for the linings of acid equipment: High-temperature cements to add life and strength to the entire refractory structure.

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Let's put the cork back in the red ink bottle

How? By making the gasoline we need from the cheapest charging stocks at lowest cost

Let's crack up our stored fuel oil and gas oil and light distillates and leave the crude oil we don't need in the ground

Dubbs cracking is the way to do that

There's profit, too, in Dubbs cracking because fuel oil is cheaper than crude and it makes better gasoline

The Dubbs process is always the answer

Universal Oil Products Co
Chicago, Illinois

Dubbs Cracking Process
Owner and Licensor

averaging about 0.83 gpm in this loop hook-up; consequently there is very little gasoline made under these pressures and temperatures. From this scrubber, the gas enters the absorbers, two in number, which have a capacity of 30,000,000 cubic feet each, and were fabricated by Jackson Engineering Company. These towers were designed to operate with either mineral seal oil, or other lighter absorbing mediums. Successful operations have been carried out with kerosene as the absorbent.

From these absorbers, the gas travels back to the engine room where a portion is used through the high pressure cylinders in the gas lift operations of the plant. The remainder of the gas is sold to the pipe line companies engaged in marketing natural gas as a fuel.

The oil circulation is handled by motor-driven, Goulds, centrifugal pumps. It is picked up by a series of three-stage pumps and sent through the Bentube cooling coils, and then through an orifice in the line to the absorbers where it comes into contact with an average of 20,000,000 cubic feet of gas daily. From the absorbers, the absorbing medium flows through another three-stage, centrifugal pump, driving it through a Jackson heat exchanger and preheater to the especially built evaporating, dephlegmating stabilizing still. This apparatus handles with ease the low initial, low end point absorption medium. No especial attention is paid to fractionation in this unit. The only specifications that the plant operators are required to meet, are end point and color. Production in this plant will average 15,000 gallons daily, some of the lighter fractions of which are derived from the distillation of oil in the company's crude reduction plant, located on the same plot of ground. All of the production made in this plant is sent to a central natural gasoline rectification plant, where it is stabilized and treated for its slight sourness.

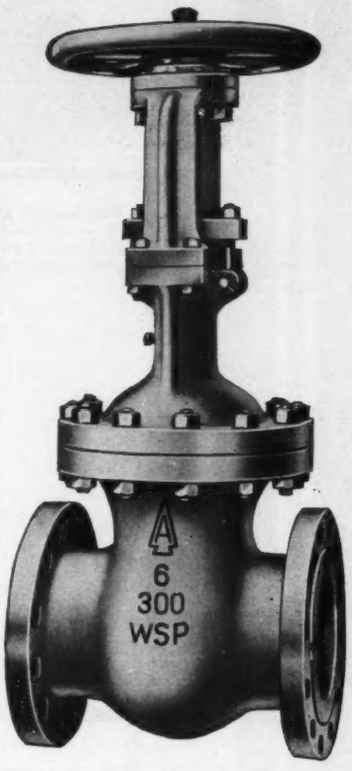
ELECTRIC PLANT

Electric power has been purchased until a short time ago, when, after some deliberation and experimenting, the company installed its own electrical generating machinery. The equipment in this installation consists of two, 250 KVA, type DS-253, two-tage, non-condensing, General Electric, steam, turbine-driven alternating generators. They have as exciters 5½ KW built integrals and on the same shaft with the alternator and turbine. This unit requires very little attention, having on the power, or steam intake end, a special governor which allows the unit to operate up to its rated speed of 3600 r.p.m. This type of electrical generating equipment is somewhat new to the natural gasoline manufacturing industry. More often than otherwise, electric power has been produced by gas engine driven equipment. These generators are housed in a building adjacent to the boiler room and in this building all of the control apparatus have been placed. Very complete switch-board equipment is used, having all the indicating instruments needed to show at a glance, the load, voltage and amperage being generated and used. All wiring is placed in conduits underground, and every precaution has been taken to provide safety for the men operating these units.

Some of the exhaust steam from this unit is utilized in the still for agitation purposes; a part is used for heating the oil in the skimming plant; and the remainder is condensed in a battery of GR Bentube sections before it is returned to the boiler feed water heater and condenser. This boiler feed water heater and condenser is the latest type as built by Tulsa Boiler and Machinery Company, and all water used by the boilers, passes through it.

The steam plant consists of seven 125 H.P. 250 pound wp Kewanee oil field type boilers. These boilers are all equipped with Copes automatic water-level controls, and a steam actuated fuel regulator. They are each equipped with non-return valves, which prevent a back-flow of steam from one boiler having a high pressure to another having a considerable lower pressure. Therefore, in the event of the failure of one boiler, the steam pressure would not be reduced on the others on the line, as well as another hazard minimized. These boilers, as well as all the steam lines leading to the various units are well insulated and steam is being delivered to the point of utilization with a minimum amount of condensation.

Men in charge of Indian Territory Illuminating Oil Company's gasoline plant. At left, C. B. Woods, superintendent of the crude oil stabilization plant; center, P. H. Shunkey, district superintendent of gasoline plants; right, A. D. Crisp, superintendent of the Button lease plant.



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Refinery Working

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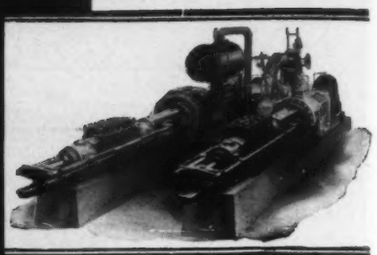
Pump

1000° F.

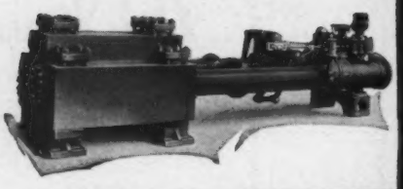
800°

500°

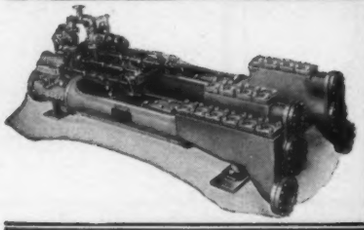
80°



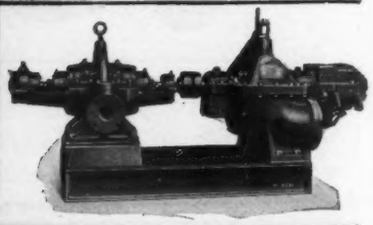
Worthington Horizontal Cross-compound Crank-and-flywheel Pumping Engine for 1000° oil



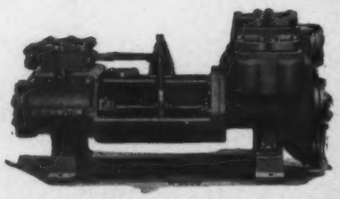
Worthington Horizontal Duplex Piston Pump for 800° oil



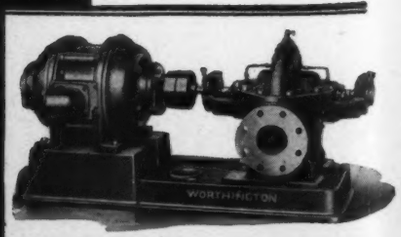
Worthington Horizontal Duoplex Piston Pump for 500° oil



Worthington Horizontal Steam-turbine-driven Centrifugal Pump for 500° oil



Worthington Horizontal Duplex Piston Pump for cold oil



Worthington Horizontal Ball Bearing Centrifugal Pump for cold oil

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and Auxiliaries
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Literature on request

FEW, if any, divisions of industry employ more varied types of pumping equipment than does the refining of crude oil. Yet the refiner finds in the Worthington line the type of pump to take care of each of his requirements.

In the lower temperature ranges, Worthington offers both centrifugal and reciprocating types. For service above 500° F., there are the various types of reciprocating equipment . . . steam-driven pumps, power-driven pumps, surge pumps, crank-and-flywheel pumps . . . employing the time-proven Worthington forged steel and cast steel pump cylinders, to insure absolute safety at all temperatures and pressures.

The development of Worthington refinery pumps has progressed hand-in-hand with and, in many cases, has anticipated the growth of the petroleum industry. The experimental stage was passed years ago and today the equipment bearing the Worthington name has to its credit performance records covering long periods of successful operation.

At strategic points, in and near the refining centers, Worthington maintains district offices manned by engineers of long experience in refinery pumping.

The services of these men are at your command in the study of your problems . . . and a point worth considering is the fact that their recommendations are not biased by any limitation in type of equipment or of manufacturing facilities.

Telephone or write to the nearest Worthington office

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P-148

WORTHINGTON

Refineries Drawn to Cheap Oil in East Texas

IN excess of 30,000 barrels of new refining capacity is assured for the East Texas district as result of the recent development of a major supply of high gravity sweet oil production in Rusk and Gregg counties. This expansion of refining activities is also accompanied by a revival of the industry among small plant owners in Louisiana and Arkansas, as the latter are again able to obtain an adequate supply of desirable crude through making tank car shipments from East Texas fields.

Seven refineries for the new East Texas oil district are under construction, while several more are contemplated for erection. Most of the plants now underway have booked fuel oil contracts with the railroads that are to enjoy their tonnage, and some of the plant owners are makng long time gasoline contracts at a fixed scale of prices as crude has been contracted for at fixed price levels.

Deep inroads in the export gasoline market formerly enjoyed by North and Central West Texas refineries and some Group Three plants will be made by the new East Texas plants and also by the Louisiana-Arkansas group. East Texas crude yields an excellent grade of gasoline without expensive treating costs, and the plants are equipped to turn out such a commodity.

RAIL TARIFFS

East Texas and the Louisiana-Arkansas group of plants enjoy a rail tariff of .0099 cents per gallon in delivering gasoline to Coastal export terminals, while North Texas refiners have a rate of .0135 cents per gallon, and those in Group Three territory are assessed .0145 cents per gallon. In addition to the freight advantage the former have and will continue to have for an indefinite period cheaper priced crude to operate on. The Louisiana-Arkansas district independent refiners for months have been forced to pay premiums to get crude supplies locally, then the supply was invariably the lower gravities, as the major companies had booked the supply of choice grades of crude. Such a condition virtually eliminated the independents from cornering the gasoline export business with their freight advantage. Export business is dormant at present.

Installation of a 10,000-barrel daily capacity topping unit has been undertaken by the Taylor Refining Company at Tyler, Texas, with provisions made for a direct pipe line connection with the Rusk County fields. East Texas Refining Company is winding up construction work on its 6000-barrel refinery at Friars Switch, Rusk County, and has broken ground for a duplicate unit at Longview, Gregg County. Freeman W. Burford, Dallas, is president of the East Texas Refining Company, and long time fuel oil contracts have been made with the I&GN and Santa Fe Railroads.

WEST TEXAS REFINERIES BUILDING

J. D. Wrather, who has heretofore operated refineries in Panhandle and West Texas as the Amarillo Producers & Refiners Corporation, is at work on a 3000-barrel refinery to be located at Overton. J. P. Gillen, Houston, and a group of interests with production in the Joiner field, are also to install a 3000-barrel refinery at Overton. Beacon Oil & Refining Company will begin testing its 2500-barrel skimming plant located northwest of Henderson by the middle of March, while a similar sized plant will be located at Friars Switch, between Overton and Henderson, by the Sabine Oil & Pipe Line Company. L. H. Gray, El Dorado, Arkansas, is head of the latter concern, and is now operating in Arkansas as the Southern Oil & Refining Company.

Erection of a refinery in the Fort Worth-Dallas trade territory by Sinclair Refining Company is likely to take place within a few months, as result of this concern having greatly expanded with wholesale and retail outlets in the above district, and especially in East Texas. Sinclair Oil & Gas Company has also becomes entrenched with production in East Texas, and is in position to supply such a plant with crude.

The following refinery projects are underway in East Texas:

Builder—	Daily Capacity	Railroad Connection	Shipping Point
Amarillo Prod. & Refiners Corp....	3,000	I&GN	Overton
Beacon Oil & Refining Company...	2,500	I&GN	Henderson
East Texas Refining Company.....	6,000	I&GN	Friars Switch
East Texas Refining Company.....	6,000	Santa Fe	Longview
J. P. Gillen et al.....	3,000	I&GN	Overton
Sabine Oil & P. L. Company.....	2,500	I&GN	Friars Switch
Taylor Refining Company	10,000	Cotton Belt	Tyler

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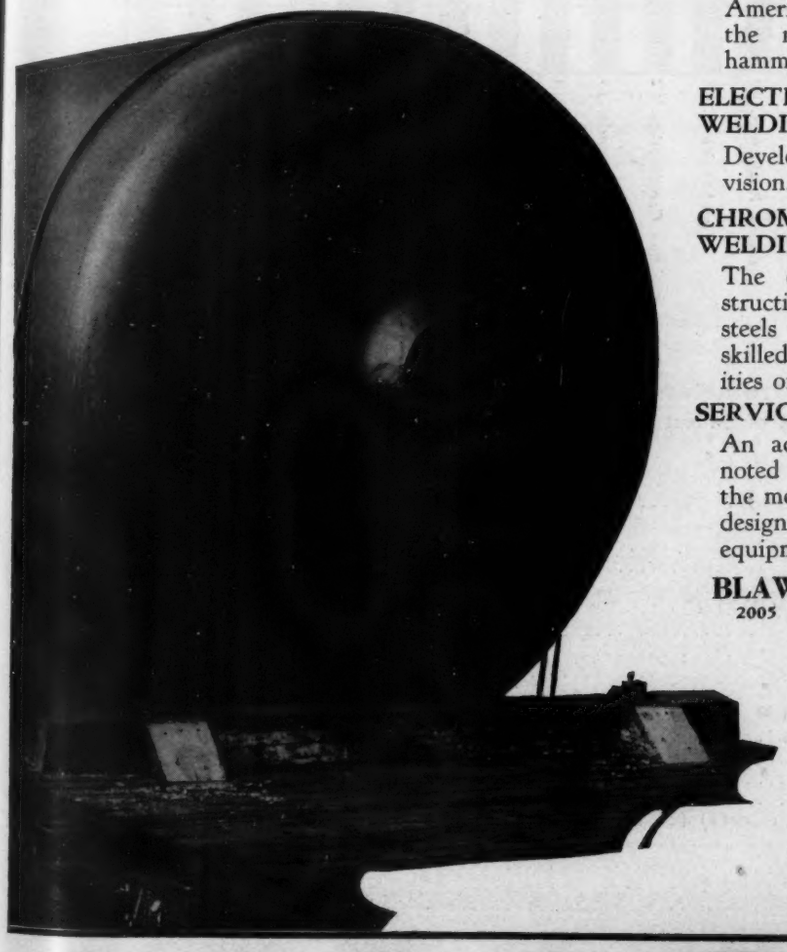
An exclusive electric welding development—stronger and more ductile than the original plate. The latest development in scientific welding!



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A special plant, one of the few in America—devoted exclusively to the manufacture of forge and hammer welded equipment.

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Developed under expert supervision.

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The delicate and difficult construction of vessels from alloy steels requiring the attention of skilled metallurgists and the facilities of a highly trained personnel.

SERVICE

An advisory board of engineers noted for their familiarity with the metallurgy of welding and the design and construction of welded equipment.

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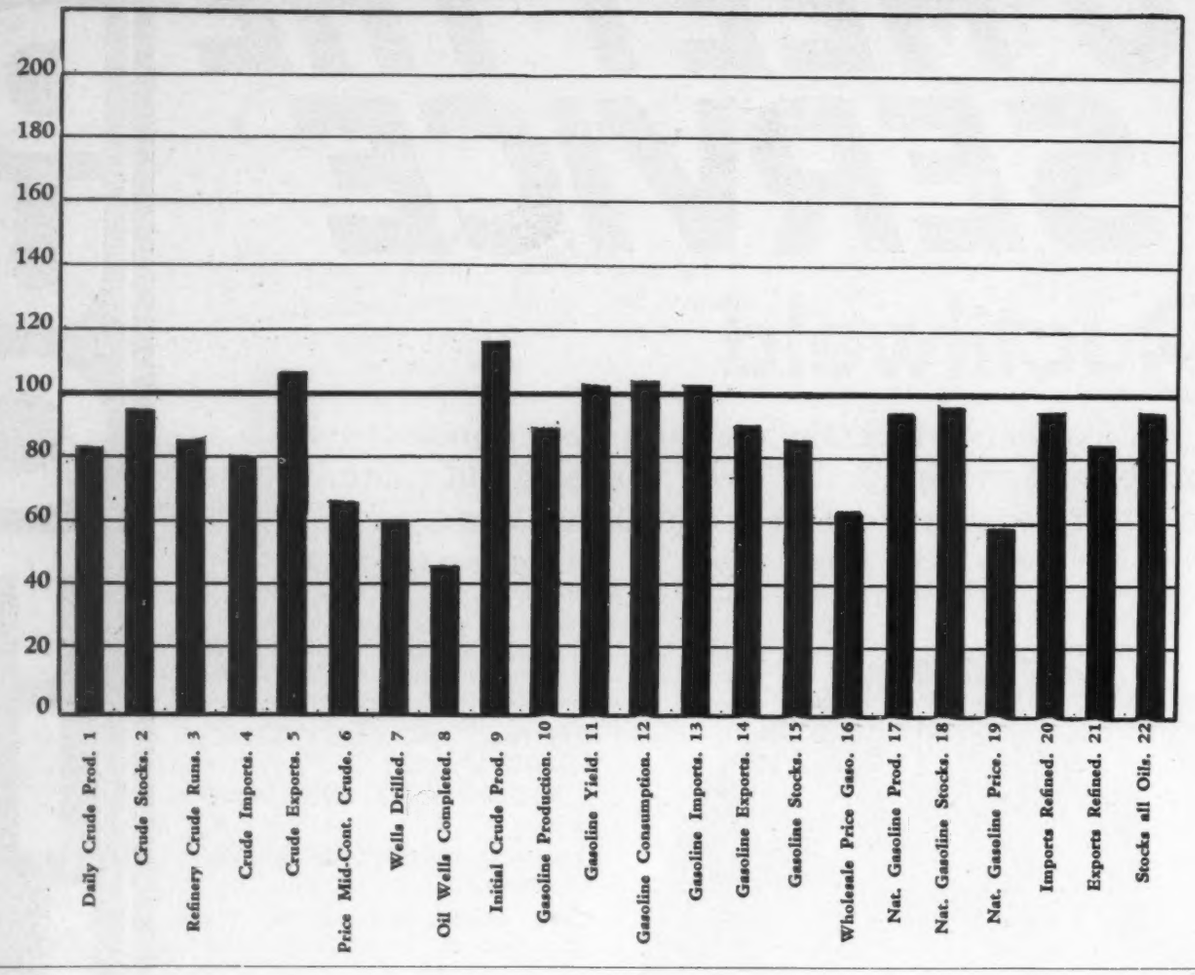
DUCTILITY

BLAW-KNOX

Salient Oil Industry Factors for January, 1931, Expressed in Per Cent of January, 1930. Heavy Line (100) Represents January, 1930



Oil Industry Barometer—January, 1931

Index of Salient Factors

	Factors—	This Month—Last Year	This Month—This Year	Index (a)
1	Daily Average Crude Production (Thous. Bbls.)	2,572	2,129	83
2	Total Crude Stocks (Thous. Bbls.)	535,167	509,185	95
3	Refinery Crude Runs (Thous. Bbls.)	80,163	70,026	87
4	Crude Imports (Thous. Bbls.)	5,450	4,353	80
5	Crude Exports (Thous. Bbls.)	1,808	1,919	106
6	Posted Price 36 gravity Mid-Continent Crude (Bbl.) (b)	$1.45	$.95	66
7	Wells Drilled*	1,918	1,156	60
8	Oil Wells Completed*	1,142	519	45
9	Initial Crude Production* (Thous. Bbls.)	685	797	116
10	Gasoline Production (Thous. Bbls.)	36,654	32,708	89
11	Gasoline Yield—Average Per Cent of Crude (d)	41.03	42.08	103
12	Domestic Gasoline Consumption (Thous. Bbls.)	25,791	26,844	104
13	Gasoline Imports (Thous. Bbls.)	1,079	1,116	103
14	Gasoline Exports (Thous. Bbls.)	5,527	4,903	89
15	Gasoline Stocks at Refineries (Thous. Bbls.)	49,676	42,818	86
16	Refinery Price U. S. Motor Gasoline, Group 3 (Cents) (c)	6⅞	4¼	62
17	Natural Gasoline Production (Thous. Bbls.)	4,410	4,140	94
18	Natural Gasoline Stocks (Thous. Bbls.)	611	606	99
19	Price Grade "A" Natural Gasoline, Group 3 (Cents) (c)	5¼	3½	67
20	Imports all Refined Oils (Thous. Bbls.)	3,806	3,601	95
21	Exports all Refined Oils (Thous. Bbls.)	12,037	10,091	84
22	Total Stocks all Oils (Thous. Bbls.)	693,833	662,196	95
	Weighted Index of Supply	.....	.....	95
	Weighted Index of Demand	.....	.....	88
	Weighted Index of Prices	.....	.....	65

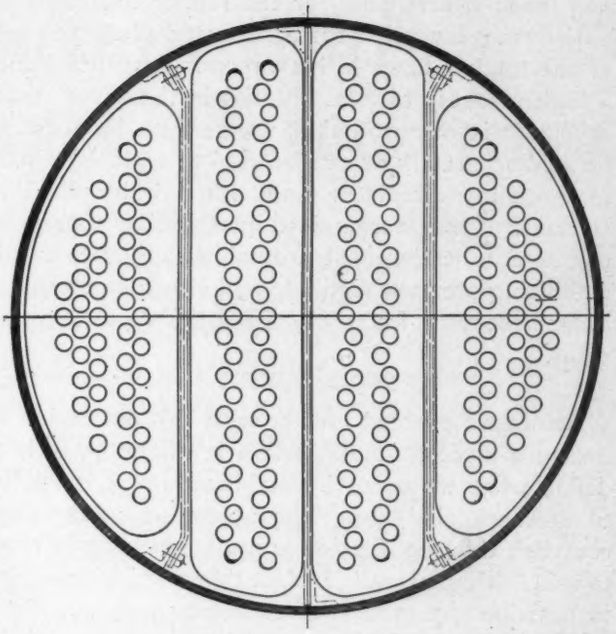
*Exclusive of Rocky Mountain area.
(a)—Last Year—100.
(b)—Weighted Average.
(c)—Monthly Average.
(d)—Straight run and cracked gasoline only.

HEATING
a 23° gravity residue
from 200° to 720°F

THE LEACH FRACTO CONDENSERS shown in the photograph heat 23° gravity Winkler County residue (cracking coil fresh feed) from 200° F. to 720° F. without a perceptible deposition of coke in the tubes. The B.S. and W. content of the oil ranges from .4 to .6 per cent. Coke formation has been encountered in other apparatus heating the oil over a considerably smaller temperature range. The successful operation of the Leach exchangers is due to the use of the proper tube size and number of passes as dictated by previous experience.

The heating medium is vapors at 750°F. to 780°F. from the vaporiser of a Tube and Tank cracking coil. Although the vapors are dirty, the entrained coke and tar is washed from the vertical tube surfaces by the condensate running down the tubes, and it has never been necessary to shorten cracking coil runs for cleaning of the exchangers. There are no transverse baffles to afford lodging place for coke. All cleaning is done in a few hours while the coils are down as the vertical shells are easily removed. The tubes are spaced on wide centers and the tube bundle divided into four parts with lanes permitting every tube to be reached and cleaned by sand blasting or scraping. (The photograph shows the shells lifted for sand blasting the tubes.)

The exchangers are of Leach patented design with cast channel and tube sheet and with vapor baffles permanently fastened in the shell and sliding between the floating heads when the shell is removed. Four floating heads prevent loosening of the tubes due to temperature shocks.



LEACH FOUR HEAD DESIGN
4 Vapor Passes

The C. H. Leach Company build heat exchangers for oil refining only. Special designs have been developed to meet high temperatures and pressures, corrosion and fouling as encountered in refinery service.

The Leach Fracto Condenser is fully protected by patents in this country and foreign countries.

C. H. LEACH COMPANY
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9-11 PARK PLACE NEW YORK

LEACH Fracto Control TRADE MARK REG.

Pressure Distillate Stabilization and Refinery Gas Recovery Systems

(*Continued from page 76*)

consequently we can use a gasoline for blending containing considerably more butane than we could if the pressure distillates were not stabilized. It is purely a vapor pressure calculation. For each volume of propane we remove from the pressure distillate, we can replace with approximately 3½ or more volumes of butane, and still have the same vapor pressure on our final product. It is this relation that has made it profitable for the refiner to design his vapor recovery plant for a recovery of 90 per cent of the total butanes in his vapors. In general such a high recovery of total butanes in the vapor recovery plant is not profitable, unless such butanes can be sold separately or can be used to replace propane in pressure distillates and other light distillate streams. From a complete quantitative survey we can determine the most profitable method to use in stabilizing pressure distillate and also the percentage butane recovery we require from the vapor recovery plant.

TERM DEFINED

Before we proceed further with this discussion on pressure distillate stabilization it might be well to define what we mean by stabilization as it applies to pressure distillate. The apparatus used to accomplish this rectification is most generally referred to as a "debutanizer." In fact this word is now used to describe any process of rectifying pressure distillates without particular regard to the purpose of the operation. Originally the purpose of a "debutanizer" was to remove, under control, light fractions, so as to avoid subsequent handling and distillation losses. In some plants this purpose has become secondary to facilitating distillate treatment for color and stability. For the purpose of this paper we define pressure distillation stabilization, as any control process of rectification, which removes essentially all the propane from the pressure distillate without regard to the quantity of butane removed.

All the distillates produced by cracking contain constituents capable of forming gum. One of the known sources of gum is the polymerization of unsaturated hydrocarbons. This tendency to form gum is accelerated by reheating the pressure distillate to an elevated temperature. There is some maximum temperature to which the pressure distillate can be heated without increasing the gum content in the bottom or stabilized product. Thus the stabilizing equipment should be so designed that the reboiling temperature will be below this maximum temperature. The stabilizing process should decrease rather than increase the treating cost.

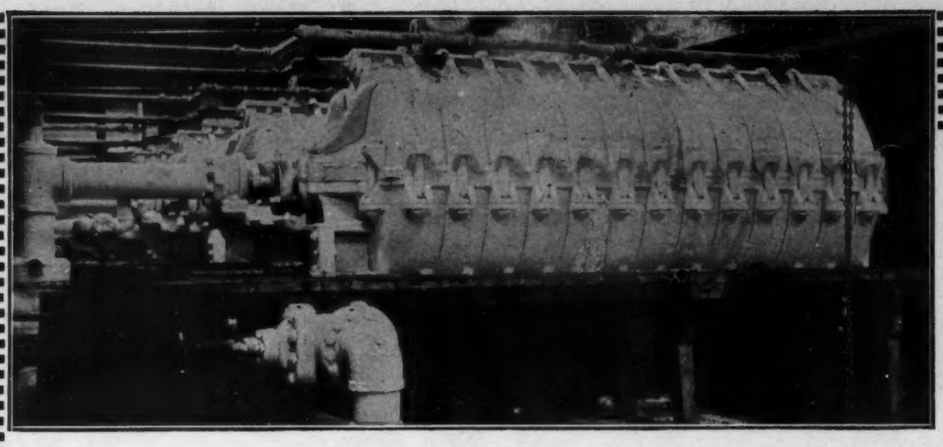
Many of the cracking plants use Gray towers for treating pressure distillates in the vapor phase. This gasoline is finished with respect to color and perhaps end point if auxiliary fractionating tower used ahead of Gray tower but very seldom with respect to gravity and vapor pressure. In most cases it will be profitable to stabilize this product for there generally is an appreciable quantity of propane present. In studying this Gray tower gasoline it is necessary to determine the maximum temperature to which it can be heated before it begins to show unstability as to color, as well as the maximum temperature without showing increasing tendencies to form gum. The lower temperature of these two will be the deciding factor and in general the reboiling temperature in stabilizing treated Pressure Distillate is lower than the reboiling temperature in stabilizing untreated Pressure Distillate.

Now before we proceed with the discussion on the actual process equipment for pressure distillate stabilization, and since our paper is dealing with this stabilization plant as a part of the vapor recovery plant, we can include here the additional items necessary in our preliminary survey which have a bearing on the vapor recovery system.

1. Quantity, pressure and composition of gas from each source.
2. Value and characteristics of the various absorption oils available.
3. How will the vapors from your storage tanks be handled? Will you have a vapor return system or will you release air into the tanks when pumping from them?
4. Quantity of Hydrogen Sulphide present in vapors?
5. Effect of compression on corrosive properties of these vapors.
6. Ground space available.
7. Interest and depreciation rates to be used in determining annual operating cost.
8. Probable average load factor on plant.
9. Wage rates of operating personnel.
10. Administrative burden.
11. Prospects of refinery expansion which may require extension of vapor recovery system.

With all these above facts, and also the facts which were required for the pressure distillate stabilizing plant, the process engineer is now ready to consider available processes.

A basic flow diagram is presented in Figure 1. The flow remains essentially the same regardless of



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Less Retained Oil in Press Cake. Uniform, homogeneous cake formation is obtained in the Vallez Filter—which means highest filtration rates, clearer filtrates and highest cake washing efficiencies.

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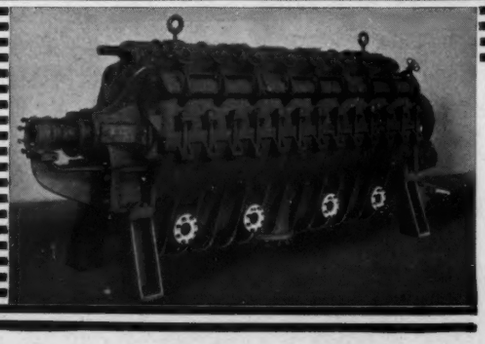
VALLEZ *Rotating Leaf* FILTER



Write for Filtration Bulletin 4a

GOSLIN-BIRMINGHAM MANUFACTURING CO., Inc.

Vallez Filter Division: 15675 Lathrop Ave., Harvey, Ill.
(Chicago Suburb)
Works: Birmingham, Alabama
New York Office, 82 Beaver Street

Address Inquiries to Harvey, Illinois

the amount of butane and propane overhead. The operating method can be modified in many different ways, to meet the conditions most profitable to your particular refinery such as character of reboiler medium, pressure on column, combination of partial and final condensers but unless more than one overhead and one bottom product are desired, it remains a single column. An exception to this case would be, should your refinery already have a vapor recovery plant operating at low butane recovery from your vapors, and you desire to stabilize your pressure distillate without remodeling your vapor recovery plant for high butane recovery. Then it might be economical to use two columns in the pressure distillate stabilizing unit, taking overhead butane and propane from the first column, compressing this overhead product and fractionating between propane and butane in a smaller high pressure column.

Under the items mentioned in the preliminary survey for the pressure distillate stabilizer, we stated that rectifying the pressure distillate accomplishes two purposes. The original purpose was to remove light fractions so as to avoid subsequent handling and distillation losses, but more recently this purpose has become secondary to facilitating distillate treatment for color and stability. The value of debutanization from this standpoint comes about through obtaining an overhead cut of from 15 to 30 per cent of the total pressure distillate which requires only a sweetening wash. Thus a treating cost of 5 to 10 cents a barrel, and a corresponding loss to acid of from 1 to 2 per cent of the pressure distillate treated, is saved, and at the same time treatment of the remaining distillate is facilitated through ease of handling a stable distillate. This saving in treating cost has added materially to the profits to be derived from pressure distillate stabilization.

It is very difficult to establish the net increased yield obtained through the stabilization of the pressure distillate. By recycling of condenser and tank vapors into the vapor recovery system, many refiners believe that if they do lose it one place, they will get it another place. However we have found that those refiners who keep an accurate overall record of their various operations, are able to trace a very distinct increase in the net yield which can be directly credited to debutanizing. The various figures we hear vary from 1 to 4 per cent. It is our opinion that this increased yield is not due so much to the reduction of evaporation losses as it is to better utilization of the volatile fractions, for as I have stated before the elimination of a small percentage of propane and lighter make possible their replacement by three to three and one-half volumes of butane. Most operators now appreciate the tenacity with which these small percentages of undesirable constituents are held by the pressure distillate throughout the whole of their ordinary refining operations.

In many instances vapor locking tendency is blamed on low initial boiling point, high gravity, or the use of too much natural gasoline in blending but in most cases, which we have observed, the difficulty is due to an appreciable amount of propane and lighter constituents, which could have been eliminated with a considerable increased yield of finished product, if attention had been given to distillate rectification in the refining process.

ECONOMICAL RECOVERY

After we have made the complete survey of the refinery as outlined in the preceding paragraphs, we are now ready to prepare a preliminary estimate on which can be based comparative costs of the recovery plant for different percentages of gasoline extraction from the gas. The controlling factor in most plants is the butane extraction. In one plant recently coming within our knowledge the controlling factor was propane, as this particular refiner had a market for his propane. This propane recovery however is not a factor of great importance at the present time, as with high butane extraction, we necessarily extract high percentage of propane, and in most cases more than the refiner can market.

If all the pressure distillate has been debutanized and the recoverable butane can be used, and its value is considered equal to that of heavier constituents, it is usually considered economical to recover at least 90 per cent of the butane in the gas. Occasionally low butane content, low cost of power for pumping oil, low cost of compressing gas, minimum corrosion expense, and other factors so reduce the operating cost that it becomes worth while to recover as high as 95 per cent of the butanes, although such a plant may cost 20 per cent more than a plant for recovering 90 per cent. This cost of extracting high percentages of butane varies widely, depending largely on the percentage of butane in the gas, and its relation to the percentage of pantane and heavier. The percentage of butane extraction becomes one of the most important factors in the determination of oil circulation, absorber pressure, and, in fact all of the plant design.

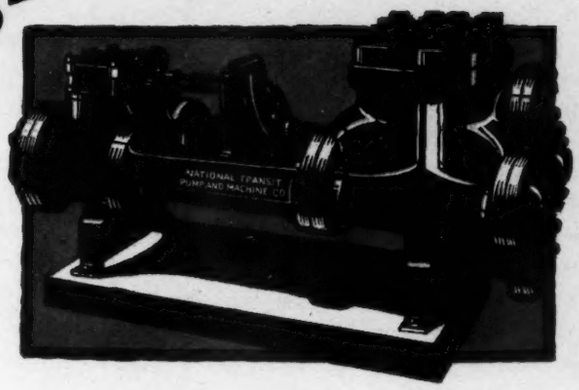
The next important decision then to be made is what absorption pressure to use. Before making this decision, we must develop the following operating costs:

1. Cost of pumping absorption oil against pressures 30 to 300 pound gage.

2. Cost of compressing gas from the available suction pressures to discharge pressures from 15 to 250 pounds gage.

In studying the two above costs, we must also take into consideration the characteristics of the absorption oils available at your refinery. There is still much to be learned as to the desirable characteristics of absorption oil. In general the viscosity should be low, as this promotes turbulence, high

Living up to a Lithograph



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transfer rates and low pressure drops. The boiling range should be narrow preferably 375 to 500°F. The molecular weight should be low, because since absorption is a molecular function, the oil circulation varies almost directly with the molecular weight. Good practice requires an absorbing oil of about 180 molecular weight. Since the absorbing of hydrocarbons is calculated in mols of oil rather than gallons of oil, a high molecular weight oil adds unnecessarily to gallons of oil required, which adds to the investment in practically all parts of the plant, as well as the operating costs of pumping, heating, and cooling. It should be kept in mind, however, that the characteristics of the oil may change in service, and therefore it is advisable to select an oil which can be economically replaced.

With all this information regarding characteristics of absorption oils, and the cost of pumping oil against various pressures, as well as the cost, including initial investment and operating cost, of compressing gas against various pressures, we endeavor to find the economic pressure at which to operate the absorbers of the vapor recovery plant. There is a great diversity of absorber pressures now in use by our largest refineries varying from 15 pounds to 250 pounds. At the very high pressures, which requires two stages of compression, the operating cost of compressing the gas due mainly to aggravated corrosion at the high pressure, makes the total operating cost of the plant higher than if a lower absorber pressure was used with a much greater oil circulation. One large refiner reported recently that the average cost of compressing his gas from atmosphere to 250 pounds, taken over a period of a year, was in excess of 4.5 cents per thousand. A large part of this cost was expensive replacements and upkeep to his compressor due to corrosion.

ABSORPTION PRESSURES

The general consensus of opinion, at the present time, regarding absorption pressures, seems to be between 35 and 80 pounds. These pressures fall within the limits of a single stage compression. For high butane extraction, the tendency is to use pressures between 60 and 80 pounds and for relatively low butane extraction about 35 pounds. A true study of the economics of absorption pressures, will, in general, prove that it is more economical from an operating point to circulate oil than to compress the gas above the pressure attainable with single stage compression.

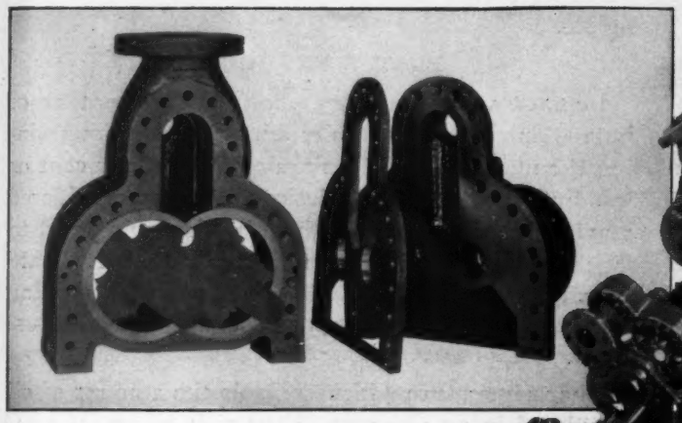
DETERMINATION OF PROCESS

After having determined the butane extraction required, absorption pressure, and absorption oil to be used, in conjunction with the other information tabulated, the process engineer can now definitely calculate the oil circulation and proceed to the determination of the distillation process.

The typical conventional low pressure distillation unit is shown in Figure 2. Considerable variety can be applied in the method of extracting the gasoline from the oil. If the percentages of methane, ethane, and propane in the rich oil are relatively high, it is usually advisable to provide a suitable vent to eliminate as much as possible of this light material, without serious loss of desired fractions, before the distillation takes place. If these high percentages of so-called fixed gases remained in the oil and flashed in the still, it would necessitate high condenser pressures, or uneconomical reabsorption. High condenser pressures can be obtained only by high still pressures or compression. Recompression is fundamentally undesirable, if avoidable, as it adds to first cost, operating costs, ground space, and an element of operating fallibility which can be eliminated only by installing a spare recompressor at further added cost. High still pressure, if applied to a single column distillation system, is objectionable because the steam consumption, which varies with distillation pressure becomes excessive and exhaust steam, which is frequently available cannot be used. Consequently it has been the problem of engineers whose main interest is economical operation to modify this distillation equipment so as to accomplish the advantages of high condensation pressures without the disadvantages of high distillation pressures. Especially were they confronted with this problem in distillation, when very high butane recovery was desired, in which case the butane to be condensed most always was greater in quantity than all the heavier gasoline constituents combined.

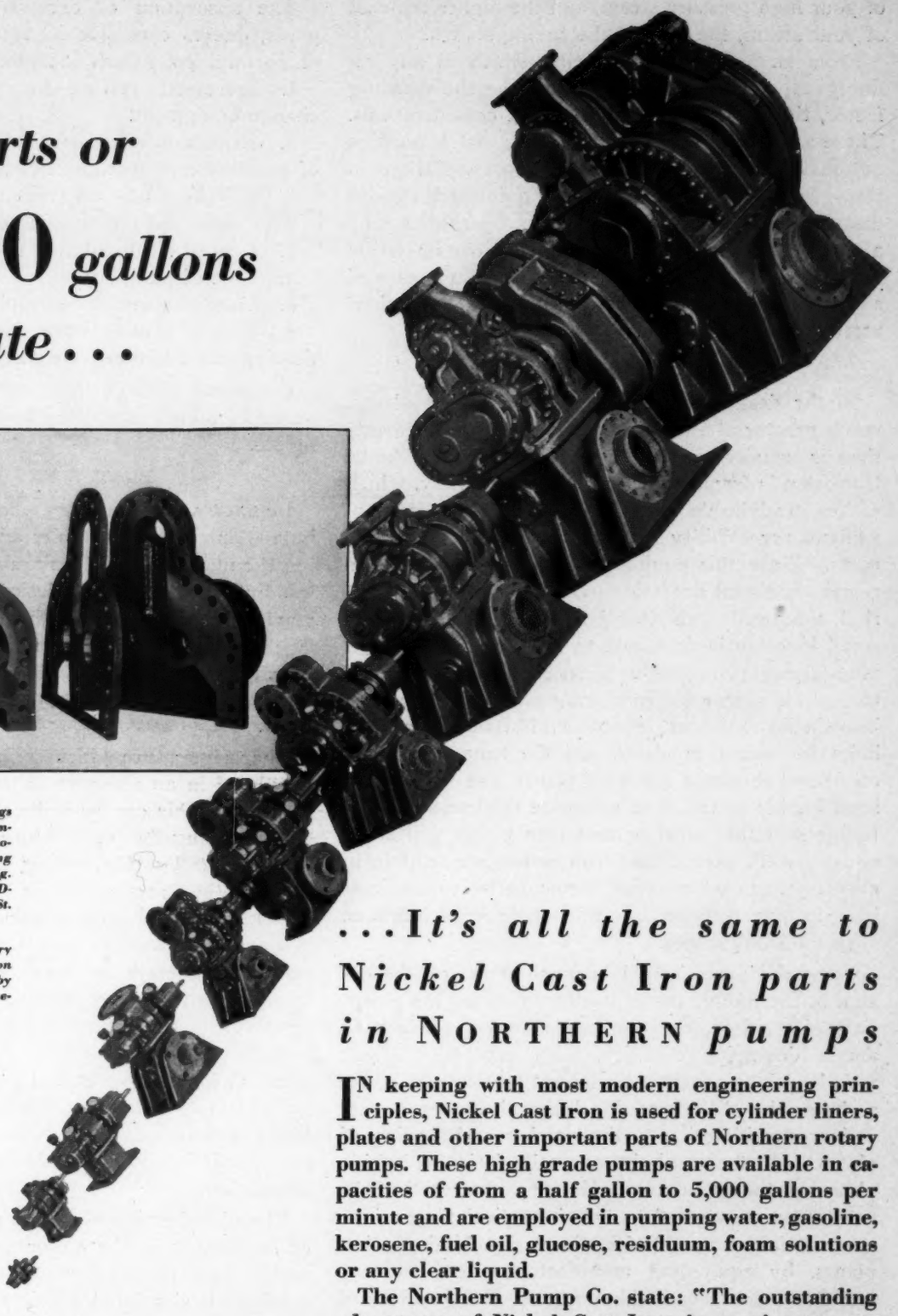
The economical solution of this problem is the use of two stills in series, the first one operated at about 80 pounds and the second one at about 10 pounds. Since complete stripping in the high pressure still is not desired, very little high pressure steam will be required. Only sufficient steam should be used so as to reduce the vapor pressure of the partially stripped oil down to the absolute pressure on the low pressure still. This will insure practically complete condensation in the low pressure condensers of the vapors distilled off in the low pressure still. Since the second still, or low pressure still, is operated at about 10 pounds, it makes possible the use of exhaust steam for stripping purposes. The vent or uncondensed vapors from the high pressure still being at about 80 pounds, frequently correspond closely enough in composition to the rich gas to permit returning them directly to the absorber inlet, thereby eliminating separate reabsorbers or recompressors. Since the absorbers pressure in these high butane recovery plants is generally close to 80 pounds, it would be impossible, without recompression, to return these condensers vent vapors direct to the absorber, unless the distillation pressure is slightly in excess of the absorber pressure. The economics of the two still distillation units is a function of the cost

5 *Quarts or* 5,000 *gallons a minute...*



ABOVE: *Nickel Iron castings used in Northern pump assemblies. Nickel up to 3%, chromium up to 2%, depending upon size and type of casting. Castings produced by MIDWAY FOUNDRY CO., St. Paul, Minn.*

RIGHT: *10 Northern rotary pumps—using Nickel Cast Iron for various castings. Mfd. by the Northern Pump Co., Minneapolis, Minn.*



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IN keeping with most modern engineering principles, Nickel Cast Iron is used for cylinder liners, plates and other important parts of Northern rotary pumps. These high grade pumps are available in capacities of from a half gallon to 5,000 gallons per minute and are employed in pumping water, gasoline, kerosene, fuel oil, glucose, residuum, foam solutions or any clear liquid.

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of your high pressure steam, and the higher the cost of your steam, the greater the saving shown.

From an operation standpoint, which in any refinery vapor recovery plant should be the deciding factor, there are two very important considerations. These are: 1., flexibility in capacity; and 2, positive automatic control. Extreme and rapid variations in rates, due to starting up or shutting down of various units, are characteristic of refinery operations, and a vapor recovery plant to give satisfactory operation must be able to smooth out these variations as well as handle gases and vapors of widely different characteristics.

DESIGN OF EQUIPMENT

In the design of refinery vapor recovery plants, much greater attention must be paid to refinements than is usually considered justified for field plants. Corrosion is frequently severe in the refinery, which makes it advisable to design all equipment for convenient accessibility and replacement of attached parts. Since this equipment can be counted on to remain in useful operation over a relatively long period compared with field equipment, the relatively small increase in first cost to make the interiors of all equipment accessible, is easily justified. Bubble towers should either have removable plates packed into shells, or should be provided liberally with manholes for access to plates. At the temperatures encountered in vapor recovery plants, the warping of steel bubble plates, if of adequate thickness, is negligible so either steel or cast iron plates will serve equally well, except cast iron is less susceptible to corrosion. Good practice seems to be to use cast iron in the construction of bubble caps, throats, seals, and downpipes.

Some engineers have laid much stress on the design of the bubble plates itself. Provided the essentials of good plate design are adhered to, such as ample downpipe capacity, with especially ample weir length or overflow periphery particularly in absorbers, the difference in design becomes a secondary consideration to the number and spacing of plates. Most any of the properly designed bubble plates of today have an efficiency greater than 50 per cent as compared to the theoretical plate. The greatest folly committed in the design of absorption plants, by equipment manufacturers and refinery engineers, has been skimping on the number of plates in absorbers, stills and fractionating columns.

In absorbers especially, this skimping of number of plates, adds to both the first cost and the operating cost of the plant. An insufficient number of plates necessitates the circulation of excess oil, resulting in absorption of increased amounts of fixed gases. The perfect absorber would be one which absorbed only the hydrocarbons desired, and the greater the number of plates the more nearly we approach true selective absorption.

The absorption of excessive amounts of fixed gases, due to excessive oil rates introduces a train of harmful conditions including:

1. Increased pressure drop through the heat exchange equipment.
2. Reduction of transfer rate and partial pressure of gasoline constituents in condensers.
3. Increased load on recompressor or reabsorber.

The additional oil circulation increases:

1. Cost of all distillation unit equipment.
2. Cost of pumping oil.
3. Cost of steam for stripping oil.
4. Cost of cooling water for cooling oil and condensing the additional steam.

Compared with all these additional costs, the expense of additional plates in the absorbers is negligible.

PLATES REQUIRED

In most vapor recovery plants the percentage of butane extraction is the deciding factor in determining the number of plates required. If 50 per cent or less butane extraction is desired, it is not considered good practice to use less than 16 plates. For 80 to 90 per cent butane extraction, the absorber should have at least 24 plates and several excellent refining engineers believe that as many as 30 plates are justified.

The temperature which controls the amount of oil circulated in an absorber is the rich oil outlet temperature. This can be reduced in two ways, either by decreasing the temperature of the lean oil to the absorber or by intercooling in the absorber or by both. When accomplishing high butane extraction at 60 pounds or higher this oil temperature rise through the absorber may be 30 to 40°F. In this case it is generally economical to apply intercooling in the absorber. By maintaining a relatively low temperature throughout the tower, the partial pressure of the butane in the rich oil is kept relatively low. This same low partial pressure of butane could be achieved without intercooling only by the circulation of additional oil. In some cases, intercooling may result in a saving of 25 to 30 per cent in the oil circulation.

The absorber is one of the most important pieces of equipment in the vapor recovery plant, but no matter how perfect it may be, and no matter how much oil is circulated, efficient extraction of the gasoline from the gas is impossible, unless the rich oil is thoroughly stripped in an efficient still. The still is the heart of the recovery plant. Insufficient stripping plates will necessitate the use of excessive direct steam. Good practice indicates that the still should have at least eight stripping plates. The inlet oil temperature should be within 20 to 40°F. of the temperature of the available heating steam. The temperature of the partially stripped oil near the base of the still is of greater importance than the

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inlet oil temperature, as it is this temperature at the base where the extraction of the heavy gasoline ends takes place which controls the quantity of direct steam used. If the quantity of gasoline in the rich oil is high in percentage, as is generally the case, when operating the vapor recovery plant for high butane extraction the temperature drop in the oil in passing through the still is considerable, and it should be reheated before reaching the bottom plates. As the only purpose in reheating is to reduce the quantity of steam required for stripping the heavy ends, it is obvious that the oil should be reheated after the temperature lowering due to distillation of the light ends, but before final contact with the steam. This is best accomplished by locating the reheater well down the column, but above at least two or three of the final stripping plates. The use of internal heaters is not recommended, as these heating surfaces may require inspection, cleaning or replacement due to corrosion. With an internal heater, such work will require a plant shutdown. An outside heater can be by-passed with only temporary reduction of economy due to increased direct steam while the heater is being by-passed.

The rectifying part of the still should be directly above the stripping plates, and should be built into the same tower. This rectifying section is of great importance particularly if light absorption oil is used. The rectifying plates should be ample to insure returning all the evaporated absorption oil to the still with a minimum of gasoline. Good practice calls for eight rectifying plates with at least one water draw-off plate. End point control can be accomplished in three ways: 1, pumping back gasoline; 2, pumping pure water operating on a closed system; or 3, the use of reflux condensers. Either of these three methods will provide control of the end point, but most of the refining engineers today prefer the pumping back of gasoline.

COOLING EQUIPMENT

The cooling equipment in any refinery vapor recovery plant is of great importance. The absorption oil coolers are especially important and should be designed to cool the oil to within five to six degrees of the temperature of the circulating water. A one degree temperature reduction in the absorption oil to the absorbers, effects a saving of approximately two per cent in oil circulation.

Either open or closed cooling systems can be used, and both give excellent results. The open system is generally preferable if the circulating water contains an appreciable quantity of depositing solids. Closed coolers are more compact, and generally are more convenient to install.

In any cooling system by-passes should be installed to permit the cleaning of any individual cooler without shutting down the plant. The inside of the tubes on closed coolers should be accessible without breaking any pipe connections.

If the vapor recovery plant has been designed for high butane recovery, which high butane recovery has consequently increased both first cost and operating cost, the final fractionating unit must necessarily be designed for close separation between propane and butane. The important considerations entering into the design of this unit are:

1. Flexibility in capacity and quality of feed. This fractionating unit in a refinery is required to operate satisfactorily under heavy loads in summer, light loads in winter, and a great variety of other conditions brought about by varying the quantity and quality of gas to the recovery plant.

2. Design of column for sufficiently high operating pressure. This column must withstand sufficient pressure to insure the condensation of propane under the worst operating conditions. With operating temperatures such as prevail during the summer, columns are usually operated between 200 and 225 pounds per square inch gage, but they should be designed for safe operation at 250 pounds should the raw feed be relatively high in ethane and methane.

3. Ample number of fractionating plates. Thirty plates should be the minimum number for close separation and in some instances forty plates are justified. A great number of plates adds considerable flexibility to the unit.

4. Ample reflux condenser surface. The amount of reflux to the top plate for separation between butane and propane, should never be less in quantity than the feed, and if the overhead is great, and the cut desired very sharp the reflux required may be twice this quantity. Reflux condensers are generally located near the ground, the reflux being collected in an accumulator and pumped back to the top of the column. If a rate of flow controller is used, this system provides for very accurate control.

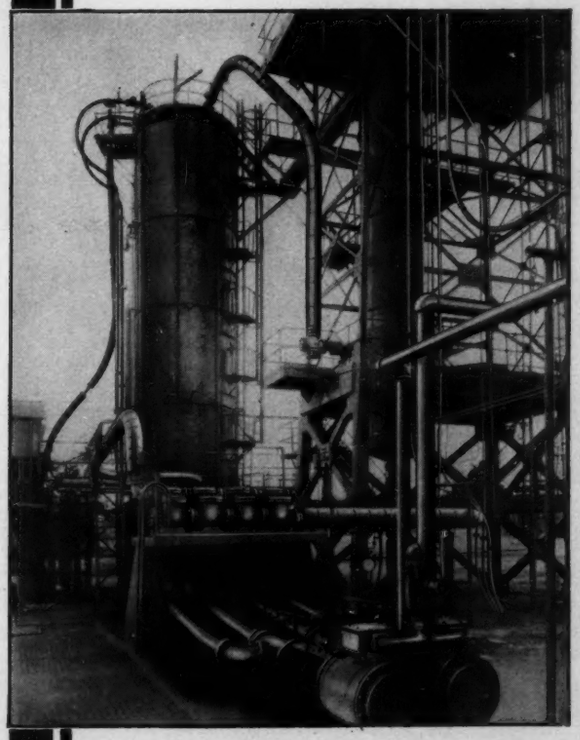
5. Ample reboiler surface. This reboiler should have sufficient surface to re-evaporate all the reflux plus the evaporation of the overhead product. Also sample disengaging surface should be provided so that the generation of vapors will proceed without surges.

6. Full automatic control. This may add materially to the first cost but it pays dividends many times in assuring constant and efficient operation.

Every refinery presents a distinct problem which must be studied by itself. First, there must be the complete preliminary survey, and opportunity to study all the conditions which may effect plant design. Second, given the survey and controlling conditions, the process must be carefully developed to most economically meet the existing conditions. Each part of the system must justify itself from the standpoint of operating economy throughout the probable life of the plant.

This Dubbs Cracking Unit at H. F. WILCOX OIL & GAS CO. has piping by

MIDWEST



THE oil industry has piping requirements that are peculiar to it—requirements that differ from those of the central station and industrial plant. Midwest long ago recognized this fact—and has learned from many years of close contact with the oil industry how best to satisfy these piping needs. It is significant that "Piping by Midwest" is today so generally used in refineries, pipe line pumping stations and natural gasoline plants.

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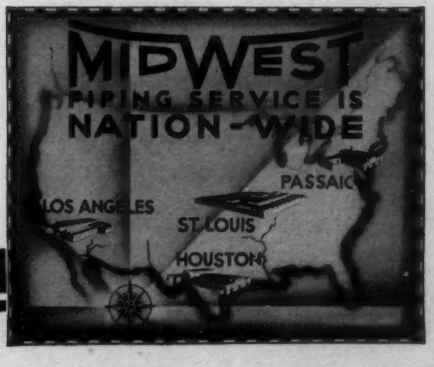

THE GREATER MIDWEST PIPING SERVICE

The Manufacture of Grease

(*Continued from page 78*)

saponification, and limitation of temperatures. This latter factor prevents complete dehydration of some special soaps.

The pressure-type steam-jacketed kettle is used in preparing the soap stock that is transferred to an open kettle where the mineral oil is added and the grease is finished. Its advantages lie in the speed with which the soap stock can be prepared, more nearly complete saponification, close control on water content and the uniformity that can be maintained. Due to using steam as a heating medium, the high temperatures necessary for complete dehydration are not reached. At the Ponca City plant of the Empire Oil & Refining Company a pressure kettle has been installed in a central location in order to supply two large open steam-jacketed kettles. A batch of soap is made in the pressure kettle and run to one open kettle where oil is added and the grease finished. While this operation is being carried out a new batch of soap is made in the pressure kettle for the second open kettle. An almost continuous production of grease is, therefore, carried on through this manipulation and due to the fact that a batch of soap can be made in the pressure mixer in 45 minutes, as compared with two to four hours in the open kettles, the plant capacity is more than doubled.

Fire heated kettles are used for the manufacture of greases that require a temperature above which steam jacketed kettles can supply. The disadvantages of their use are operating hazards and the difficult control.

A considerable saving in material cost and in handling costs is effected by purchasing the fat in tank car lots rather than in barrels. The tanks are equipped with steam coils so that the fat may be melted and pumped to a small tank located directly over the kettles and which is used to measure, accurately, the quantity of material for a batch. Aluminum metal tanks have been found quite satisfactory for the storage of fatty acid, as no discoloration will be caused even when held for relatively long periods at somewhat elevated temperatures. The mineral-oil storage-tanks are so arranged that the amount of oil can be measured accurately, and run by gravity into the grease kettles.

TYPES OF SOAP-OIL MIXTURES

A classification of the various soap-oil mixtures, with reference to the saponifying-agent or metallic-base, affords a very advantageous procedure for discussion. The greases will be discussed in the following order: Calcium, Sodium, Aluminum and Lead soap greases. Zinc and Potassium soap greases are not included since they have no special advantages and are rarely employed in the manufacture of lubricants.

Calcium or lime soap greases are in demand probably more than any other soap thickened lubricant. The commonly known varieties include the several grades of cup grease, pressure gun grease, ball and roller bearing grease, axle grease, and water pump grease. The greases, ranging from semi-fluid to semi-solid consistency contain from four to twenty-five per cent soap. The mineral oil ingredient is usually a highly refined light or medium bodied grade.

Calcium base greases may be made in two ways and are classified, according to the method used as cold sett greases and hot mixed greases.

The cold sett greases are made by simple mixing of rosin oil, lime and mineral oil. Saponification takes place and the mixture hardens without application of heat from an outside source. Rapid saponification cold is peculiar to the fatty members predominating in rosin oils. These greases are specialty products but are used extensively enough so that something more than passing notice is deserved.

The most convenient manufacturing procedure is to prepare two mixtures—a rosin compound and a sett compound. The rosin compound consists of rosin oil and a quantity of mineral oil. The sett compound consists of the lime and mineral oil. When the two compounds are brought together and thoroughly mixed, saponification takes place and after a thirty to sixty second interval, the mixture hardens. The ingredients of the compounds are so proportioned that equal parts of the two give the desired consistency. Normal room temperature is sufficient to insure satisfactory results.

Sett greases are comparatively inexpensive, and are designed for rugged duty, where the cost of higher quality lubricants is prohibitive. The greases invariably contain an excess of the saponifying agent, which, in the form of hydrated lime, is insoluble in the grease body. The excess, obviously, constitutes an abrasive element. The greases are therefore unsuitable for lubricating accurately machined parts, functioning under ordinary load conditions, since abrasion would disrupt the lubricating film.

Hot mixed calcium soap greases are made by saponifying the fatty ingredient with an accurately measured amount of hydrated lime. The chemical reaction is carried to completion in either open-type steam-heated kettles or closed-type pressure-cookers.

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5-61-89

The extended period of contact at elevated temperature enables the reaction to be carried nearly to completion.

Lime base greases are made either in open steam-jacketed kettles by the wet or dry method, in closed steam-jacketed kettles, or in a combination of two. In the dry method of making lime base grease in open-top steam-jacketed kettles, the fat, the amount of lime necessary for saponification of the fat, a small amount of non-viscous oil, and an excess of water are cooked with agitation until the fat is saponified. Agitation must be vigorous and should be more of a kneading action than a mere stirring. Heating is continued until all of the excess moisture is evaporated and then agitation is carried on with the heat turned off until the soap is slightly cooled. Mineral oil and water are added until the right consistency is reached and the necessary amount of water required for the emulsion is present. In the wet method, less water is added and the soap is cooked down to about the right water content and the oil added. This method is quicker, but more inconsistent results are obtained as there is some guess work attached to determining when the water has been reduced to the right point.

The pressure mixer overcomes the disadvantages of the foregoing methods in time saving and in securing complete saponification and uniformity. The pressure kettle is charged with definite amounts of fat, lime, water, and a small amount of non-viscous oil to soften the soap. Steam is turned into the jacket and, under the influence of heat, pressure is built up inside the kettle amounting to 65 to 85 pounds depending on the steam quality. Saponification is complete in 20 to 25 minutes and the soap is blown to an open mixer by its own pressure where oil and water are added to complete the batch. The water in the mixer is lost by flashing off when the mixer is blown out and a dry base is delivered to the open kettle to which definite amounts of water may be added. It is possible to complete the batch in a pressure kettle, however, this is not an economical practice and is seldom employed.

A well made cup, pressure-gun or roller-bearing grease, should contain practically no abrasive solid, such as excess of lime. Many manufacturers employ the practice of using a slightly insufficient amount of lime and completing the reaction with a non-abrasive agent; a practice which is quite workable with the pressure type cooker. As a further precaution against lime lumps and foreign material the grease should be pumped through a strainer in the drawing process.

Calcium soap greases are not applicable as lubricants where the temperature is apt to rise above 212°F. The grease is not a true solution of soap and oil, but is a suspension of soap and water in oil and is dependent upon the water content to maintain the grease body. Consequently at a temperature in excess of 212°F., the grease loses its moisture and a separation of soap and oil results. Excessive pressure also causes separation of soap and oil.

The stability at high temperature and pressure is greatly improved by proper selection of the fatty ingredients. Incorporation of high viscosity mineral oil is also beneficial in this respect.

The outstanding characteristics of calcium soap greases are, their insolubility in water, and short sheat or buttery texture. The texture indicates a low degree of cohesion within the grease body, which, in accordance with the lubrication theory outlined above, is the more suitable for high speed bearing lubrication. The texture also offers high resistance to flow and it is therefore advisable to apply it by means of a pressure lubricating system, or compression type grease cups. Ball and roller bearings are lubricated by packing the grease into the bearing space. Because of its resistance to flow the use of calcium soap grease, is of great advantage on bearings required to operate without attention for comparatively long periods of time. The grease is not easily displaced by the centrifugal action of rotating parts.

Calcium soap greases are not used as gear greases, except under certain conditions. In an automobile transmission a certain amount of stringiness is necessary so that the grease will follow the gears and this property is lacking in lime base greases. Calcium soap greases have less stability than some other types and should not be ued in hot weather or under hard and long driving conditions, however, this type of grease finds particular favor, due to its low yield value, in cold districts where ease of shifting gears is an important factor.

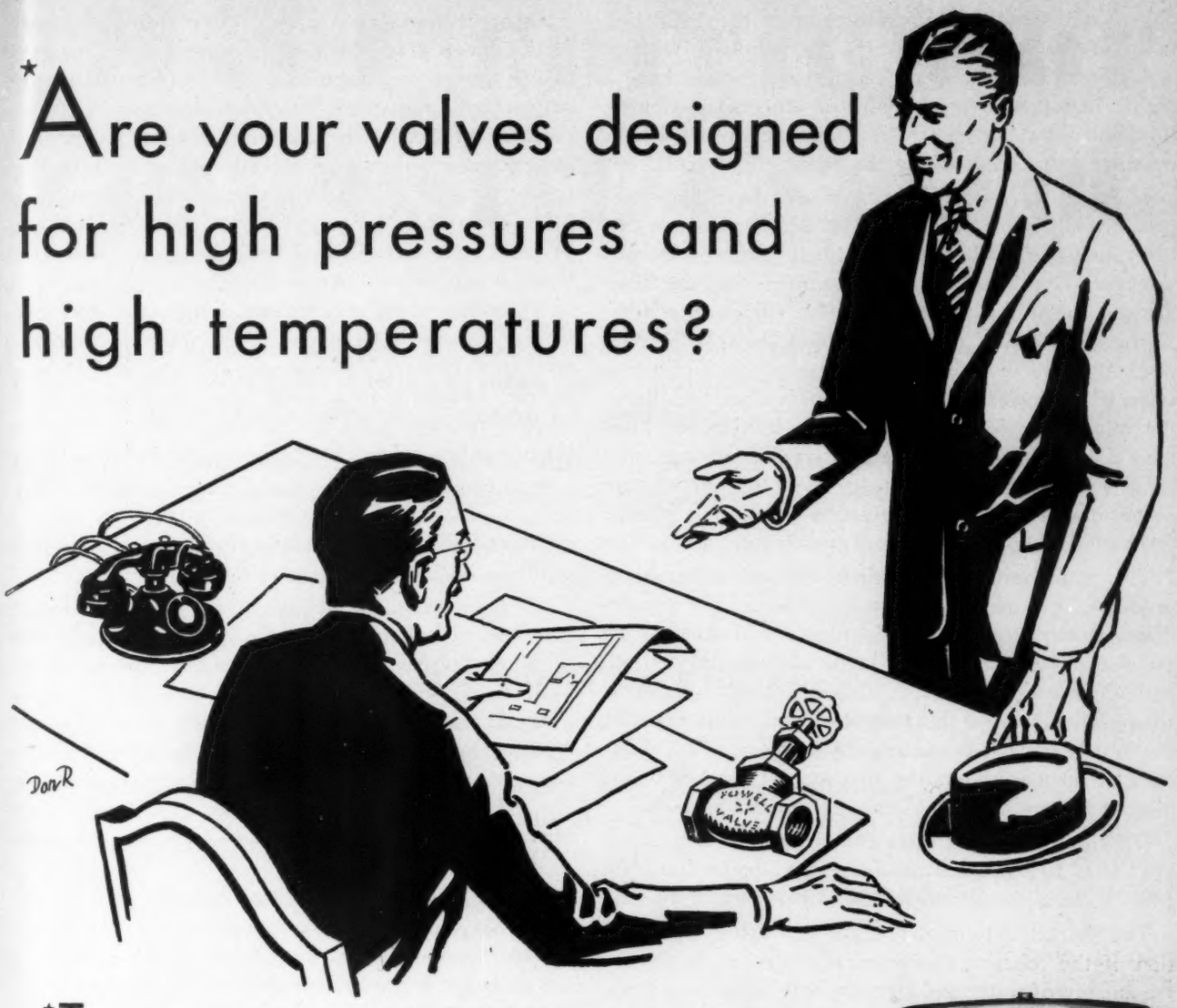
SODIUM SOAP PRODUCTS

Soda base greases are used largely for gear lubrication, and high temperature bearing lubrication. Sodium soap is water soluble, and for that reason its grease products cannot be used where they are apt to come in contact with any great amount of water.

The gear greases are mixtures of heavy bodied mineral oils, with from one-half to one per cent to 10 per cent soap, and varying in consistency from fluid to semi-solid. The gear speed is of prime importance in determining the grade of lubricant to be used. For either high or low speed, the lubricant should possess, pronounced cohesive property, and a readiness to flow. A grease sufficiently cohesive will at all times follow in a stream with the moving gear, providing, it has sufficient adhesive character to establish contact with the gear at the operating speed. The degree of cohesive is controlled largely by manufacturing procedure, and to a lesser extent by a selection of the fatty ingredient.

The high temperature lubricants contain higher percentages of soap than the gear greases. The amount ranges from 15 to 50 per cent. These greases are cap-

*Are your valves designed for high pressures and high temperatures?



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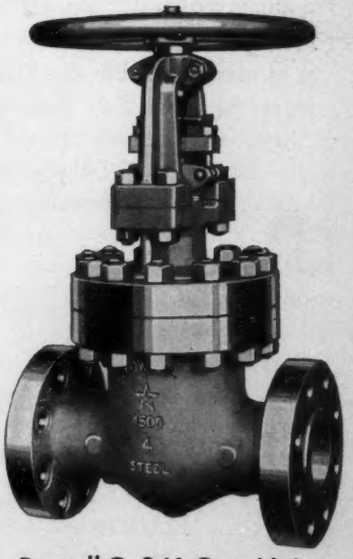
All Special Alloy Valves are produced from standard patterns. This insures interchangeability of renewable parts when needed, thus lengthening the life of the valve.



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POWELL VALVES

able of withstanding temperatures up to the distillation point of the mineral oil which they contain, without separation of soap and oil. Soda base greases have a higher liquefaction point than any other soap-oil mixture, and show less change in consistency over the temperature range approaching the liquefaction point.

There are two distinct types of soda base, high-temperature lubricants. Fiber greases which constitute one type, are so named because of their peculiar fiberous texture. The liquefaction temperatures of the fiber greases range from approximately 350°F. to 450°F. The greases are of medium hardness and can be conveniently used in ordinary compression-cup lubricating systems. Dehydrated sodium soap greases constitutes the other type of high-temperature lubricants. They have a much harder consistency than fiber greases, and show less change in consistency over the temperature range approaching the liquefaction point. The change from solid to liquid is in fact, very abrupt.

The manufacturing procedure for all sodium soap products, is essentially the same. Accurately proportioned amounts of the fatty ingredient and caustic soda are charged into the mixing-kettle. An amount of mineral oil is added before the saponification reaction is completed to soften the soap-stock, and thus expedite the introduction of the balance of the mineral oil. After complete saponification, the soap-stock is cooked to the desired texture and the balance of mineral oil added.

Dehydrated greases, after addition of the mineral oil, are heated to a temperature above the liquefaction point (400°F. or higher), and drawn to block molds to cool.

The characteristic sponge texture, which is an indication of the cohesive character, is controlled largely by the amount of water and glycerine left in the soap stock.

The use of the direct fire heated kettle is advantageous in manufacturing this class of greases as the higher temperatures possibly permit better control of dehydration. As a matter of fact this type kettle is essential in the preparation of the very high temperature greases which must be moisture free. The ordinary gear greases are very satisfactorily made, however, in the open steam-jacketed kettle. The pressure kettle finds little application in the manufacture of this class of grease although the operation may be very satisfactorily carried out. The pressure mixer will not produce a dry soap because the water necessary for hydrolysis cannot escape, therefore, no saving in time is effected as the reaction takes place quickly in an open kettle.

ALUMINUM SOAP GREASES

Aluminum base greases, compare closely in texture, and lubrication adaptability to calcium soap greases. They are often referred to as solidified oils or transparent-cup and pressure-gun greases. Aluminum-oleate blended with a low viscosity mineral oil is commonly known as Mineral Castor Oil.

These greases are characterized by their brilliant, transparent appearance, and stability at high temperatures. They offer, by far, the most perplexing problem in grease manufacture. Every ingredient plays a major part in shaping the physical properties of the resultant product. The aluminum soap of stearic acid, incorporated with a low viscosity mineral oil, yields a grease product of low cohesive character as evidenced by its short shear, buttery texture. The aluminum soap of oleic acid, incorporated with the same mineral oil, yields a product of extremely high cohesive character, and pronounced rubbery texture. Contrasted with soaps herein discussed, aluminum soap, when incorporated with an extremely high viscosity oil, yields a grease of softer consistency than when incorporated with a low viscosity mineral oil. The rate of cooling also has an important bearing on the grease texture and consistency.

It is necessary for the grease manufacturer to make an extensive study of the mineral oil, of the fatty ingredient and also of the cooling rate best suited for the grade he wishes to market.

The manufacturing procedure for aluminum soap is different than that of other soaps, in that it is a product of a substitution reaction. The fat is first saponified with caustic soda. By addition of an aqueous solution of an aluminum salt, the sodium radical of the soap is replaced by aluminum. The water insoluble aluminum soap separates, thus permitting the solution containing the sodium salts to be drawn off. By repeated washings the aluminum soap is freed entirely of excess saponifying agents.

Aluminum soap greases, when properly made, possess all the favorable characteristics of calcium soap greases, and are without the unfavorable characteristics including the possible presence of abrasive substances.

LEAD SOAP GREASES

Lead base greases, at the present time are employed wholly for gear lubrication. The soap is very deficient as a mineral oil thickener, in fact, when blended with a heavy bodied mineral oil, the viscosity (measured at 210°F.) may be decreased. Many lead base gear greases now on the market contain either calcium, sodium or aluminum soaps for the purpose of increasing the body.

Lead soap has an exceptionally high specific gravity as compared with other soaps. It is apparent from observations that the lead base lubricants possess a high degree of metallic adhesion, which may be the responsible factor of its excellent lubricating performance under heavy load at high speeds. However, offsetting this advantage is the fact that lead soap greases cause a definite lapping action on the mechanical parts so lubricated.

The usual procedure of manufacture of these greases is the fusion method, wherein the saponifiable oil is heated in direct contact with lead oxide. The objection to the process is that, invariably, an amount of uncombined lead oxide remains in suspension in the finished

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grease. By employing the substitution method of manufacture the resulting lead soap is entirely free from suspended solids.

Proper selection of saponifiable oil is very important in the manufacture of lead soap. The frequently occurring fatty acids of the Acetic series, yield lead soaps which are but slightly soluble in petroleum fractions, whereas, the lead salts of the frequently occurring members of the oleic series are quite soluble. Fats of high iodine absorption value yield the more oil soluble lead soaps. Fish oils and oleic acid are commonly used.

Sulphur is sometimes used in conjunction with lead soap for manufacturing gear lubricants. The sulphur in some lubricants is chemically combined with the soap, and in others it is physically suspended in the grease body.

There is considerable controversy at the present time in regard to the value of sulphur either suspended or combined as a lubricant.

INVESTIGATION AND DEVELOPMENT

There are possibilities for research in practically every field and with practically every product, and grease is no exception to this premise. In fact, it would seem as though less attention has been paid to greases than to a great many other petroleum products. Investigation may travel in two directions; one concerned with application in the field of lubrication, and the other with raw material and manufacturing methods.

So far as known very little investigation has been conducted concerning the relative lubricating value of soap thickened and uncombined mineral oils. In fact, the manufacturer of lubricants, until recently, has not been called upon to produce products of high lubricating value.

The automobile industry, at the present time, demands a more serviceable gear lubricant. The introduction of spiral bevel gears replacing the pinion type, presents a more severe condition of interfacial contact. Due to the design of the gear there is increased wear because of greater metal to metal contact. The rubbing action is extended over an increased distance wherein there is no contact of the face with the lubricant body. It is evident that the condition calls for a lubricant possessing a high degree of metallic adhesion, in order to form the initial film. The effect of abrasive substances is readily seen.

In the investigation of other problems as well as the one just mentioned it is questionable if investigators have attached sufficient importance to the effect of abrasive elements on lubricating-film strength. In order to accurately determine the lubricating value of any type of lubricant it appears that a study of the abrasive content is of prime importance.

It is evident that all soap-oil mixtures are apt to contain excessive amounts of saponifying agents, which are abrasive in action. The substitution method of soap manufacture yields a product free from all suspended solids.

The percentage of abrasive content of a grease product is difficult to determine. It is therefore necessary to investigate the method of manufacture of a sample as well as the lubrication performance before an index of value can be attached to any one type of soap lubricant.

A straight mineral oil lends itself readily to determination of the amount of abrasive material contained. The determination of the ash content is an accurate procedure, for uncombined mineral oils but is not applicable for soal-oil mixtures, since it includes the metal in combination as well as the amount in suspension.

This is one problem and there are many others. The present age has rapidly developed myriad types of machinery with many complex lubrication problems and in order for grease to fulfill its part, intensive study will be necessary in order to make the proper applications.

The lubrication problems, however, cannot be solved through investigation of application alone but must be carried back through manufacturing technique, even to the raw materials involved. Adequate investigation of raw materials and analysis of resultant products can be profitably made in the laboratory using small scale equipment. The results of these pilot tests may be transferred to full scale equipment with beneficial results. Many improvements in manufacturing methods are possible; for instance, the method commonly used now for drawing and cooling aluminum base greases is certainly open to betterment. While rapid strides have been made within the past few years in grease manufacture, it is entirely possible through intensive, continued research to make many more improvements which will lower operating expenses, improve quality, develop new, specialized grades and consequently rapidly expand the field for grease application.

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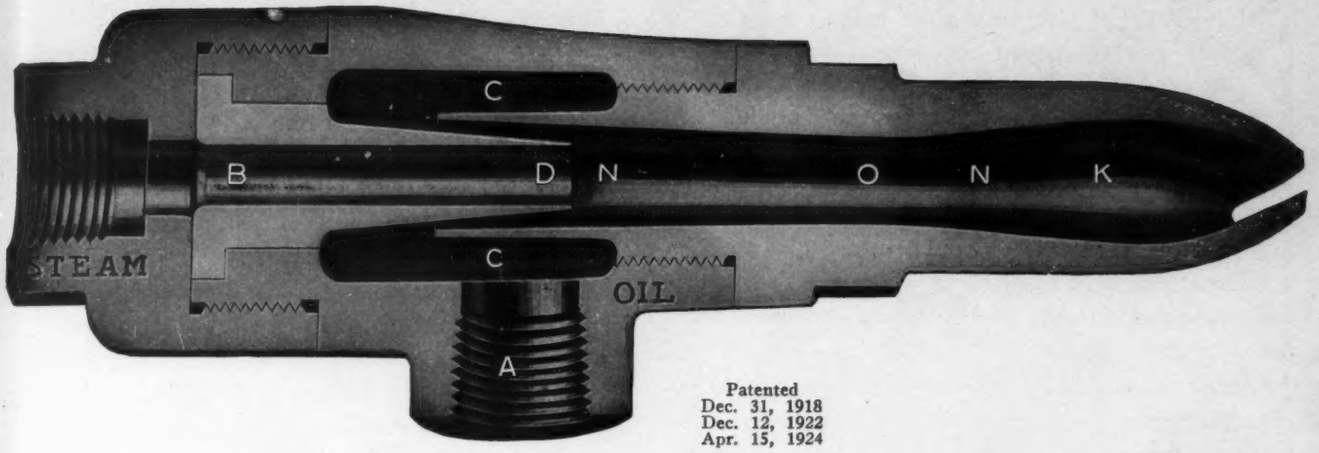
National Airoil Burners



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are internal atomizing burners—inside mixers—operating with either steam or compressed air; and burn as steady as a gas flame with any grade of fuel. Set your fire the way you want it, and it will burn the day through without watching or readjusting.

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Oil Burners and Oil Burning Equipment

Compact Distillation Unit

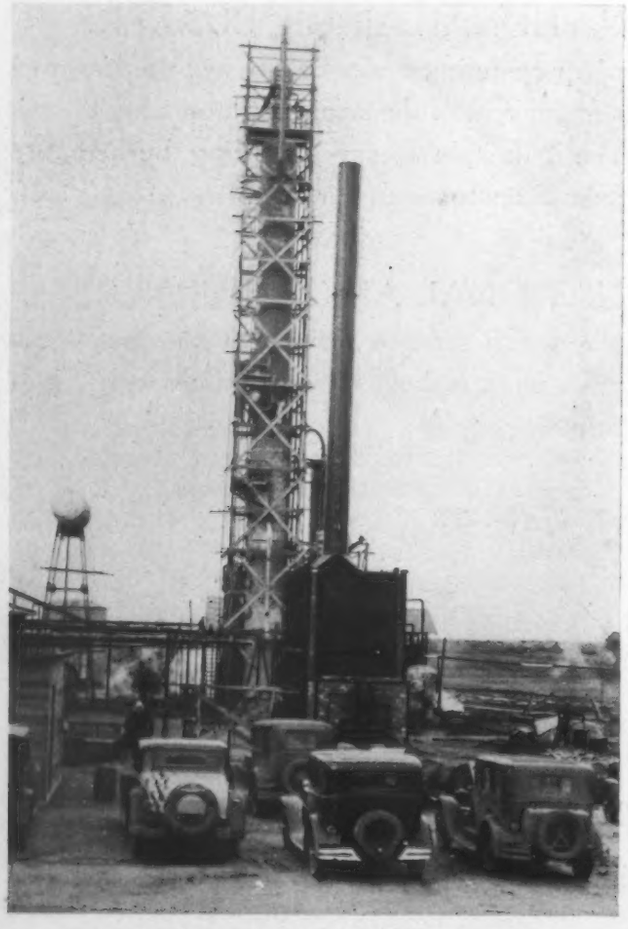
SUNRAY Oil Company after having operated its shell still equipment for several years, realized the need of modern topping equipment with which they could process the low gravity crude produced in that locality. This oil, of which Sunray Oil Company produces about 800 barrels daily on leases adjacent to the town of Allen, Oklahoma, has an asphalt base with a gravity of 31° A.P.I. It carries some salt water and a little fine sand in suspension, which makes it rather difficult to run through the distillation equipment without coking.

During the late fall, Southwestern Engineering Corporation began the erection of a compact, almost automatic plant of its latest design. It was fired up and put into operation about midnight December 20, 1930, with a normal throughput of 3000 barrels of oil.

The various units are built around the main fractionating tower, which is 60 inches in diameter by 83 feet high, with a double section reflux condenser placed on the top of it. Two auxiliary towers are included in the equipment, one of which operates as a fractionator for the distillate stream, and the other is for the gas oil cut. Each auxiliary tower has its own individual reboiler and condensers.

The tube still is located only a short distance from the tower, and contains 2000 square feet of heating surface. The tubes are placed above the combustion chamber which is lined with refractory brickwork. The furnace is fired with gas delivered to the Leahy Multi-jet burners around six pounds pressure, the volume of which is controlled by a Brown Electric Pyrometer.

The receiving house is a two-story building with the upper floor extending through to the main fractionating tower. On the floor outside of the receiving room are the secondary or auxiliary towers, reboilers, coolers and the gasoline condenser. In the receiving room are the look boxes, with the manifold controlling the streams to rundown tankage. Each line has a built-in dehydrator, taking care of the condensed steam condensed with the streams coming from the fractionators and condensers.



Sunray Oil Company's new skimming plant.

CONTROL

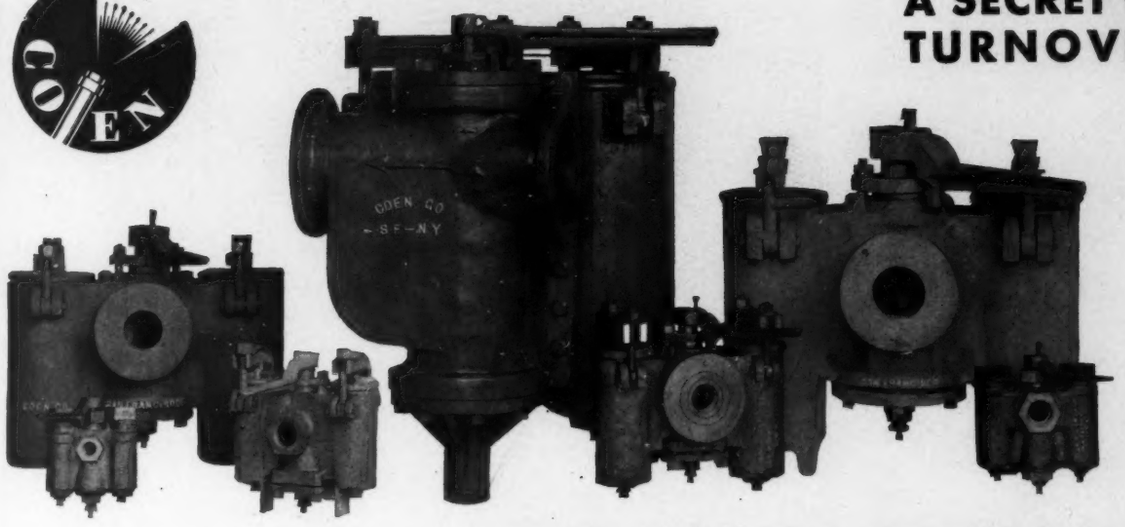
Underneath the receiving room are the pumps and the control board. Three National steam reciprocating pumps are placed, one for the crude charging stream is 7½ x 5¼ x 10-inch, the third one for handling the residue is 6 x 3¾ x 6-inch. The second one in between is 7½ x 5¼ x 10-inch and is idle, only being used when either of the other pumps need repairing.

On the control board in one end of the pump room are the instruments for measuring and controlling the temperature at vital points in the system. The Brown Electric Pyrometer recorder and actuating mechanism for controlling the furnace temperature is hung on the board, with the motor generator in behind. No high line power is available at this plant, so they must generate their own electrical energy. A Wescott fluid flow controller is set on the board taking care of the throughput volume. It actuates a Mason valve on the steam line to the crude charging pump, maintaining a constant speed. A Tycos temperature controller is placed on the board with the control valve in the water line to the reflux condenser on top of the main fractionating tower.

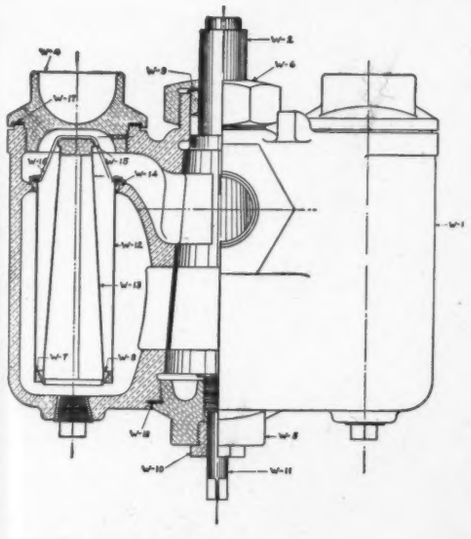
The crude cold oil is picked up from the plant storage by the charging pump and passed through the top section of the reflux condenser, then through the partial cooler on the stream from the 48-inch by 25-foot by nine-inch auxiliary tower which handles the gas oil cut. From this heat transfer apparatus, the warmed oil passes to the first heat exchanger on the ground then to the dehydrator (60 inches by 26 feet) where the salt

SPEED . . . . .

A SECRET OF TURNOVER



Coen Duplex Strainers can be furnished in sizes from 3/4" to 6" inclusive.



Cut-away view of bronze fuel oil discharge strainer.

COEN DUPLEX STRAINERS
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DUPLEX Strainers embrace the features essential for the most rapid and satisfactory operation.

A 90-degree turn of the handles changes the flow from one basket to the other without use of valves. The basket being in two parts is more readily cleaned. Strainer is so designed that when the well cover is removed the level of fluid at the well is lowered, exposing the top of the basket for removal. It is impossible to stop the flow regardless of the position of the handle. This type of Duplex Strainer eliminates the many joints necessary in those strainers which are made up of valves and fittings.

Six-inch strainers are ordinarily made of close grain cast iron or bronze. Well covers are fitted with tongue and grooved joints and are held tightly in position by means of heavy steel strong backs and hinged steel studs. The baskets are of perforated metal or reinforced wire mesh, or are made to order for special requirements, one double basket offering the combined area of perforations ten times the inside cross sectional area of the pipe. The entire strainer assembly emphasizes compactness, ease of operation and instantaneous access to working parts.

Write for Bulletin 15 giving full details.

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water and fine sand thrown out of the stream. From this unit the deposited waste is blown to the plant sewage lines. The clean oil passes from the dehydrator to the second heat exchanger then to the degasifier, a unit (48 inches by six feet, 10 inches) with a float controlled gas valve allowing the freed gases to travel to the nineteenth tray of the main fractionator.

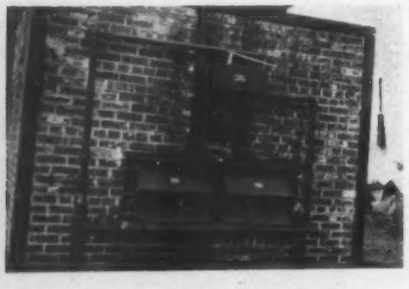
From the degasifier the oil which has been raised in temperature to around 300°F. goes to the pipe still where it is heated up to 550°F. and is then flashed into the main tower above the sixth tray.

Degasifier at Sunray Oil Company's new skimming plant, Allen, Okla.

SIDE STREAMS

Three streams are taken off the tower, the first from the top through the 10-inch overshot down through the reflux condenser which is maintained at 280°F. The vapor stream leaves through a 10-inch vapor line leading to the top of the double section gasoline condenser. This condenser is the usual tubular enclosed unit with the water passing through 480 admiralty metal tubes. The gasoline flowing directly to the receiving house through the dehydrator, look-boxes, and to plant storage. It is classed as motor fuel stocks which will be blended to specifications after treatment through the hypochlorite plant.

Two side cuts are taken from the tower, the first from the compartment above the fifteenth plate leads to the first auxiliary tower (size 36 inches by 25 feet by nine inches) which has six bubble plates. The distillate condenses down over the plates and is taken off above the third plate and sent to the reboiler entering the tower above the second plate. The stream taken off this tower at the bottom is cooled and sent to storage through the receiving house.



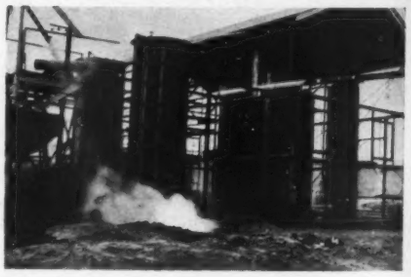
Furnace front showing pyrometer fuel control.

The second cut leaves the tower from the compartment above the ninth tray, going to the auxiliary tower (48 inches by 25 feet, nine inches), is taken off through a reboiler as in the distillate cut. Steam is injected in the bottom compartment to free the liquid vapors of any lighter fractions that may be carried over. The liquid leaving the bottom of the tower through a float controlled valve is passed through a heat exchanger imparting heat to the oil coming from the charging pump after leaving the reflux condenser on top of the tower. This gas oil cut is cooled and passed into a three-inch rundown line to the receiving house and to rundown storage.

RESIDUE

The residue is removed from the base of the main tower by suction of the residue pump, the speed of which is governed by remote control, actuated by a Neilan float operating a Wilgus valve leading to the steam chest of the pump. These still bottoms are first pumped through the reboilers in the first and second auxiliary towers, then through the two heat exchangers on the ground, cooled finally through a tubular cooler and to final storage.

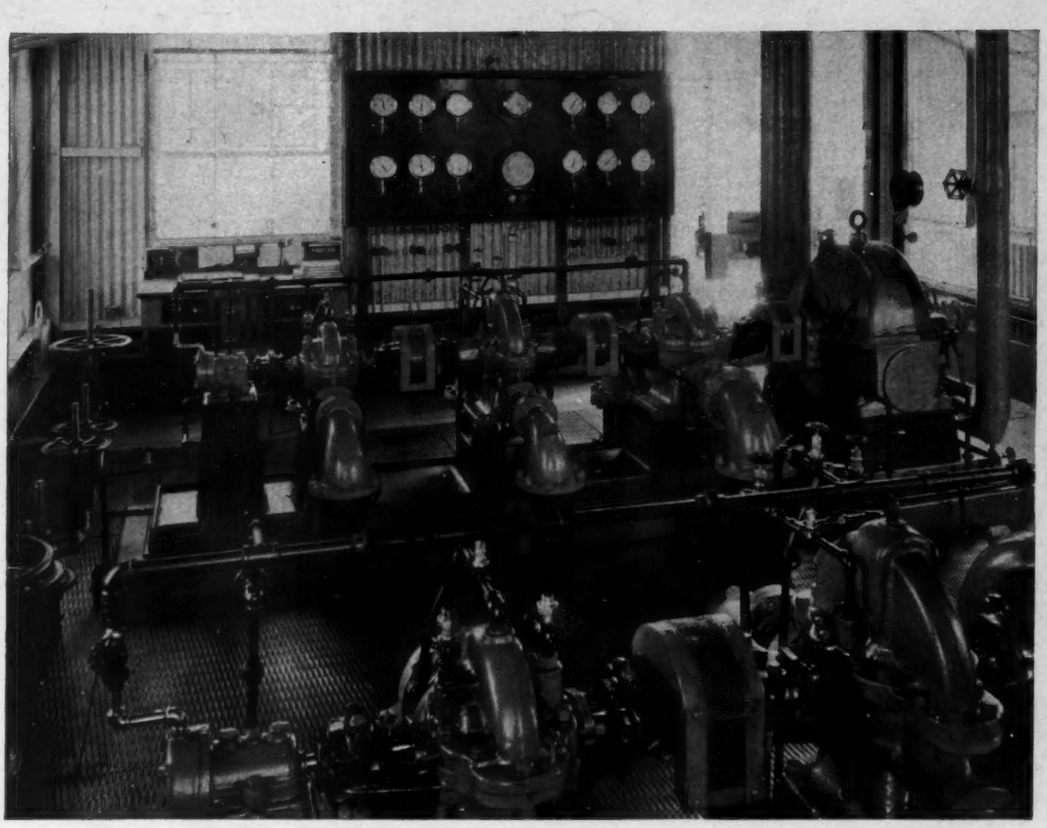
This residue is 20/22 fuel oil, and in the winter is sold as such or stored for reprocessing during the summer months. This residue has a peculiar quality that lends itself readily to the manufacture of road oils. The plant has not had any difficulty in manufacturing a product that will meet the specifications for road oil.



Sunray's new Allen plant hypochlorite treating plant.

Out of this distillation, 20 per cent of the original charging stock has been cut into motor fuel stocks, 22 per cent as 38/40 distillate, 18 per cent is 32/34 gas oil, and the residue represents 40 per cent. The motor fuel stocks after blending with natural gasoline is a premium product, having a gravity of 58.4° A.P.I., 97 initial, with a 432 end point. According to a test carried out by the Kansas City Testing Laboratories, this motor fuel has a rating of 56 per cent benzol equivalent.

TERRY



EFFICIENT TURBINE DRIVEN UNITS FOR THE GASOLINE PLANT

Illustrated above is a 133 HP Terry Turbine installed in a gasoline plant of a Western oil company.

The unit delivers 1800 gallons of water and 550 gallons of lean oil per minute.

A well balanced flow of oil and water is assured at all times. The unit is compact, efficient, flexible and occupies a small amount of floor space. Maintenance and packing problems are reduced to a minimum.

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T-1068

Made Over Gas-Lift Station Is Modern Gasoline Plant

By J. C. ALBRIGHT

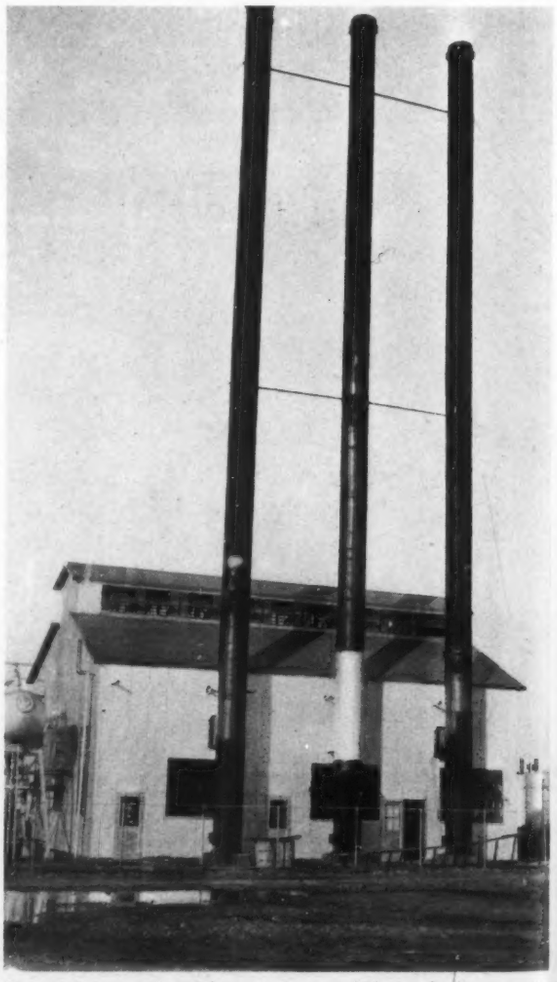
CARTER Oil Company's combination gasoline plant and gas lift station in the SW Section 20-9n-6e, in the East Earlsboro extension of the Greater Seminole oil field, represents the latest in gasoline plant installation. Built primarily as a gas lift station in the winter of 1929-30, the plant consisted of six compressors, two Clark super two's, and four 200 h.p. Cooper-Bessemers. Almost immediately six more 200 h.p. Cooper-Bessemers were installed. And in the late winter of 1930, eight more of the 200 h.p. Cooper-Bessemers were placed on their foundations. At the time that the second installation of compressors was being placed, the company decided to build a complete natural gasoline recovery plant in conjunction with the gas lift station. This plant was named in honor of the district superintendent in charge of this area. It was decided to construct and to build into this plant the most modern equipment. The name of the plant is " "Perry gasoline plant," and the superintendent in the district is A. E. Perry.

The engine room housing the 20 200 horsepower compressors, has a concrete floor which connects with a wide cement walk extending all around the building.

Inside the engine room, the first thing that a visitor sees that is different, is the inverted power cylinders, that is, the power cylinders are turned exhaust side up. Instead of the usual exhaust installation, beginning at the regulation stool, with the 45° turn downward and under the floor covered with a grating which is usually a catch-all for dirt swept from the floor into an exhaust chamber—these engines have exhaust stacks which extend vertically from the cylinders up through the roof. Cooper-Bessemer built these engines with this idea in view. All the engines have gas economizer heads, and the air is drawn into the compression chamber through an oblong opening cast into the bottom section of the bed plate, to coincide with the regular air intake flanged connection, which is usually bolted to the air chamber above and to the rear of the cylinders.

Air is drawn in in the usual manner through vertical light weight galvanized steel stacks, and is diverted down through the front part of the bed plate where it enters the compression chamber of the cylinder through the connection bolted underneath. These exhausts have a straight water jacketed manifold bolted onto the bottom, which is now the top of the cylinder. The mufflers are flanged on top of these exhaust manifolds. They were made to the specifications of the engineering department of Carter Oil Company. They are all insulated to keep the heat from the building, for with them bare, the heat emanating from them would make the room unbearable in the summer time. Bolted on top of these mufflers, is enough pipe to extend through the engine room roof. These engines were allowed to run for some time in this manner, but the fire hazard was considered too great, so another piece of larger light weight pipe was attached to the top of the stacks in which were built spark collectors and flame arrestors.

The water circulation is about the same as in other plants, traveling through and around the cylinders, coming up through the water jackets of the exhaust manifold, and draining away in the usual manner into a



Power house of modern type consisting of three water tube boilers, at Carter Oil Company's East Earlsboro (Seminole area) natural gasoline plant.

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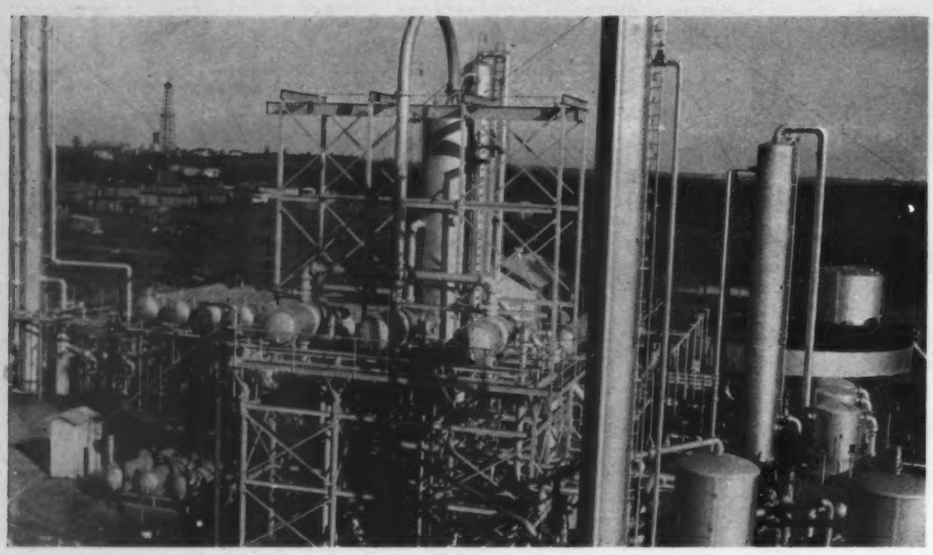


Carter Oil Company's Perry plant in the Eastern Extension of the Earlsboro field, showing compact lay-out for convenient operation.

hot well or receiving tank, which in this case is the bottom ring and floor of a 55,000-barrel steel tank. Compressed air for starting the engines is developed with an electric motor driven Ingersoll-Rand horizontal two-cylinder air compressor, connected to the motor with a short belt drive.

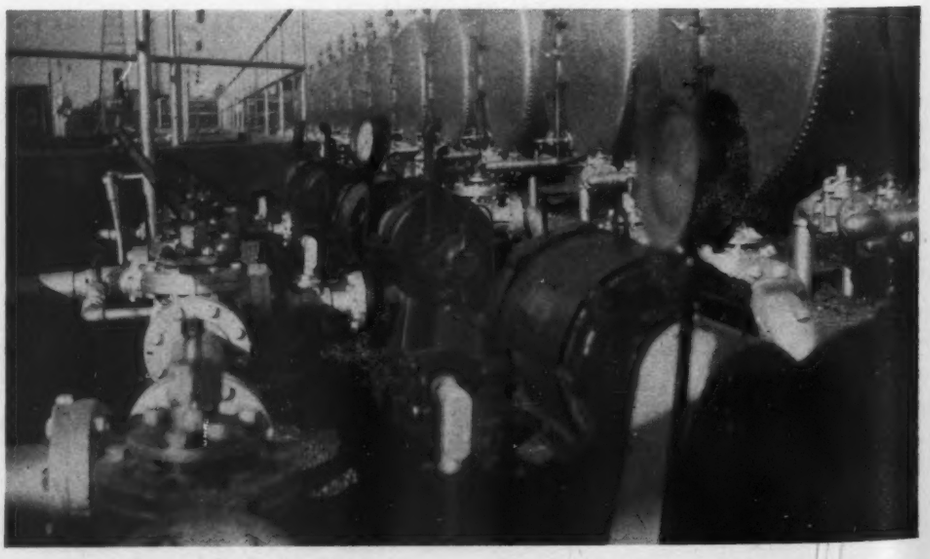
Outside of the engine room and on the compressor side of the building is the gasoline plant, which has mostly Braun equipment throughout. Two of the three absorbers were fabricated by this company, one of the gasoline rectification units, the gas coolers (both primary and inter-coolers). The heat exchange equipment, oil coolers, still and gasoline condensers being manufactured by Braun.

ABSORPTION

The gas leaving the compressors to the absorbers, is cooled by enclosed type Braun units placed horizontally, and just outside the engine room building. Leaving these coolers, the gas enters three scrubbers, where the gasoline which may have been condensed, is prevented from going to the absorbers. Both the Braun, and the other absorber, which was made by Jackson Engineering Company, are in service, having a normal capacity of 21,000,000 cubic feet of gas daily, but with an over load capacity of about 90 per cent. Leaving the absorbers, the stripped gas contains on an average of only 18 gallons of gasoline per 1,000,000 cubic feet, and is taken up by the high pressure cylinders, cooled again, and delivered to the various wells surrounding the plant for gas lift purposes.

Oil is circulated through enclosed type oil coolers, and delivered to the absorbers by General Electric Motor driven direct connected to Goulds three-stage centrifugal pumps. These pumps, instead of being placed in a conventional steel pump house, are put on concrete foundations in the open air, close up to the point where they are needed. A ventilated galvanized steel hood or housing is bolted on the frame directly over the pump motors, to prevent them being flooded during a heavy rain storm. All of the many pumps in service in this plant yard are put where they are most needed, and by doing this long suction and discharge lines as well as an expensive pump house, are eliminated.

Leaving the absorbers, the oil is picked up by another three-stage centrifugal pump, which delivers it to three sections of heat transfer apparatus, into a vent tank, and then through two sections of preheaters. The oil enters the still at 320°F. about two-thirds the way up the vertical length, where it travels down over eight bubble trays. Leaving the still from the last tray through a down spout which extends out through the still walls, the oil has lost about 20° of its heat. Entering an oil reheater, it is again brought up to 320°, and enters the still again just below the tray from which it left the still, it flows down and over eight more trays, to the bottom compartment, where live steam is injected to accelerate



Battery of pumps for handling gasoline to storage tanks and loading department. By placing pumps near the departments which they serve, long lines and pump house erection is eliminated.

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the separation of the higher boiling constituents of the gasoline from the oil.

All of the vapors given off from the vent tank between the heat exchanger and the preheater, those from the accumulator tank, and the vapors from the storage tanks, are collected in a common line and delivered to the tail or "pup" absorber which has 22 trays, taking out all of the desirable fractions of gasoline from these vapors. This tail absorber was built by Jackson Engineering, and serves the same purpose of an engine driven recompressor. Mineral seal absorbing oil is circulated over this tower in the same manner as that in the primary absorbers, and it is delivered to the still in the same stream as the rich oil in the major system.

The still is a reflux operated stabilizing unit, gasoline being used to fractionate to end point the stream of vapors leaving this piece of equipment. These low end point vapors leave the still through a long tube turndown into three horizontal enclosed tubular gasoline condensers, from which as condensed gasoline, it drops down into the accumulator tank, placed immediately beneath the condensers, and is trapped into storage.

The gasoline is now ready for the stabilizer. It is picked up by a Louis-Allis motor driven pump, and sent to the reboiler section of a Jackson Engineering Company rectifier. From this reboiler it enters the column where all of the propane and some of the butane is extracted. The light fractions coming from the tower are condensed partially in a water-cooled condensing unit placed near the ground, and is used for refluxing and cooling the top of the tower. A volume of three to one is used in this plant, and seems to give better results than any other reflux gasoline ratio. The fixed vapors, and the propane are used as boiler fuel, and the excess is vented to the air through a vent line and burned.

CHEMICAL TREATMENT

Leaving the stabilizer, the gasoline is grade AA, and is stored ready for treatment. Leaving the storage in the treating cycle, the gasoline is picked up by another Louis-Allis explosion proof motor driven pump, and sent to a pre-caustic wash tank. These motors are especially built to operate in a vapor laden atmosphere and are placed under the fire wall directly in front of the gasoline storage tanks. Chloride of lime is being used in the treating plant which is now in operation, but a new system is being built to operate on hypochlorite. The cement lined tank for chlorinating the caustic solution is all ready for service; and in a short time the entire treating system will be changed over.

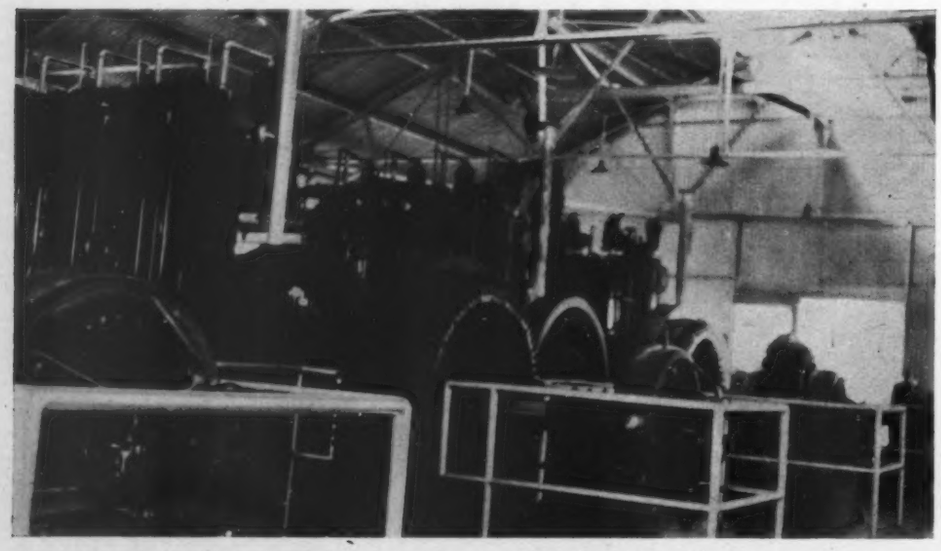
Westcott orifice meters are placed on the lines delivering the steam to the still, reheater, reboiler and preheating elements, and on the lines delivering reflux to the still and stabilizer. These are all placed in a small steel building conveniently located in relation to the various units in operation. A Leeds & Northrup potential pyrometer system of temperature recording and indicating is placed near the still, and in a small steel building built especially for this instrument. The system contains 24 different contacting lines; and at the will of the operator, he may determine the exact temperature on any one of the different points instantly.

Steam is generated by three 81 horsepower Sterling type boilers manufactured by Babcock & Wilcox. They each have a stack 120 feet high, with the boiler breeching extending through the wall of the boiler room, and entering the stacks at a point level with the top of the combustion chamber of the boilers.

Boiler feed water is made up in a horizontal combination feed water tank and preheater, built at the end of the boiler house and carried on a steel tower. This feed water is pumped into the boilers by three Dean Brothers eight by five by 12, outside piston packed boiler feed pumps. The uncondensed vapor leaving the stabilizing units is used for fuel, and is fed into the combustion chamber by John Zink short flame rectifying column gas burners.

With so many electrically driven pumps, and with the lights for the plant and camp, the company had quite a problem in the generation of electrical energy. Four 210 horsepower Hope vertical gas engines, directly connected to General Electric alternating generators, furnish all the power and lights needed for this plant. These engines and generators are placed in a building in the southwest corner of the yard, and between the engine room and the boiler house.

The gasoline plant is now handling an average of 20,000,000 cubic feet of wet gas daily.



Interior of electricity generating plant. Much of the pumping is done by motor driven centrifugal pumps.

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Development in the Carbon Black Industry

By GEORGE REID
Associate Editor

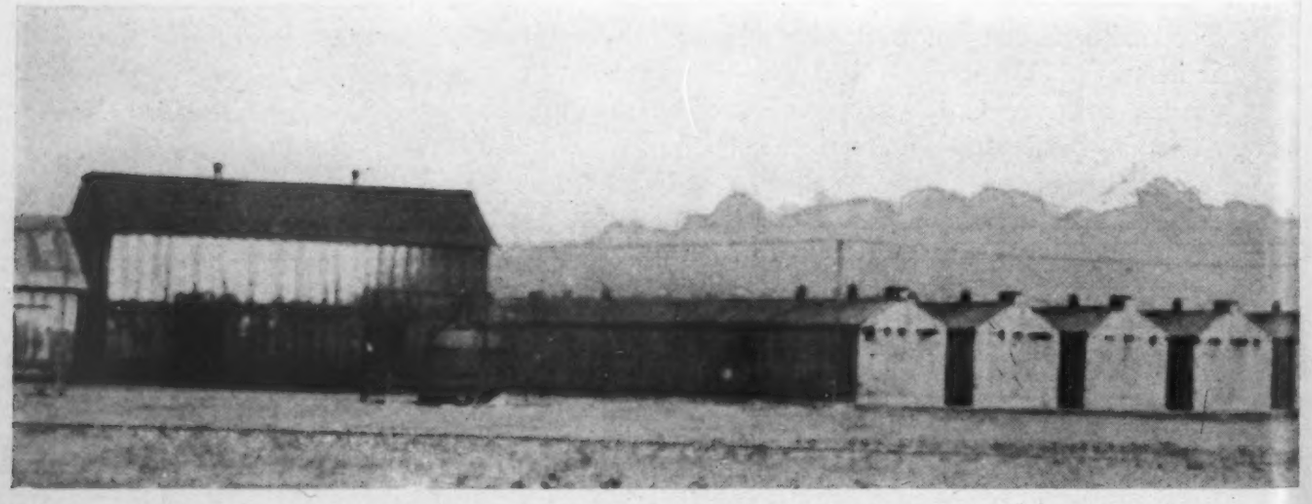
CARBON black has of recent years become of major importance, and to the extent that two other great industries are essentially dependent upon its continued production for their functioning. Automobile and truck tire and rubber goods manufacturers this year will consume about 122,000 tons of "black" and the paint and ink trades will require around 80,000 tons of this product during this year according to the estimates of one of the largest producers. When consideration is given the many millions of dollars invested in the rubber and printing industries alone, both of which are dependent upon carbon black, the vital importance of this industry is forcibly brought to view.

Although this product has been in use for about 58 years it would still be comparatively unimportant to all excepting ink manufacturers had it not been for the discovery of its usefulness in rubber in 1915. The carbon black industry owes its early existence to the printing press, but its recent growth and present important economic status is due to the rubber industry.

The history of the carbon black industry dates back to the first commercial plant for its preparation from natural gas in New Cumberland, West Virginia, in the year 1872. This plant had no regulating devices and a great amount of gas and carbon black was wasted. Gas was burned against a soap-stone slab which was used as a condensing surface. The next plant was constructed to employ cast iron surfaces for condensing the black and the product was scraped into troughs for removal. Later the cast iron plates were constructed in circular discs which were mechanically revolved around and above the gas flames, the flames at this time coming from a burner tip with a round hole in the center. This tip is still employed in the manufacture of ink grades of black, but the yield is low and the price high.

The channel process, now extensively employed, was first patented in 1892 by L. J. McNutt. The process consists briefly, of a system of channels with the flat surface placed downward over a horizontal row of stationery burners. The channels have a reciprocating motion, being slowly drawn back and forth and the black removed by fixed scrapers from the bottom of the channel, placed at fixed points above hoppers which connect with screw conveyors. This system will be discussed in more detail later in connection with improvements of a mechanical nature relating to the handling of carbon black after its production, changes of methods of operation, larger number and sizes of buildings, packing and bolting equipment and similar developments.

The term carbon black is now used exclusively to designate that product which is prepared by burning natural gas in an atmosphere deficient in oxygen or



air, in contact with a metal condensing surface with which the flame comes in direct contact, and which substance is removed by a mechanical scraper. Often carbon black is confused with lamp black and other forms of carbon in a finely divided state. When first introduced gas black was given the lengthy name of hydrocarbon gas black.

By way of differentiation in the American trade, lampblack is understood to be a soot deposited by the smudge process and made from oil, resin, or some other solid or liquid raw material: whereas carbon black is a natural gas product. Lampblack in the wider sense may be any commercial form of soot and is prepared in three different ways—first, by the combustion of dead oil of tar, pitch or resin or some other carbonaceous raw material, in an inadequate supply of air and where the floating particles of soot deposit themselves slowly upon the walls of the collecting chamber, second; it may be formed by the direct impact of the flame on a collecting surface, and third, it is formed by heating carbonaceous vapors to the decomposing point, apart from the air or flame.

Lamp black, which is soot, is often confused with bone black, ivory black, drop black, vine black, Frankfort black, Swedish black, and other charcoal blacks, and with graphite. Blacks made from wood pulp, from refuse such as leather, bone and other materials, do not possess the same flocculent characteristics as carbon black, nor the same strength of color, chemical composition or physical properties. Each black has its specific use and can not be substituted one for the other. Graphite, which is also known as plumbago and black lead, is a carbon product, and does not contain lead. The term comes from the Greek word meaning "write."

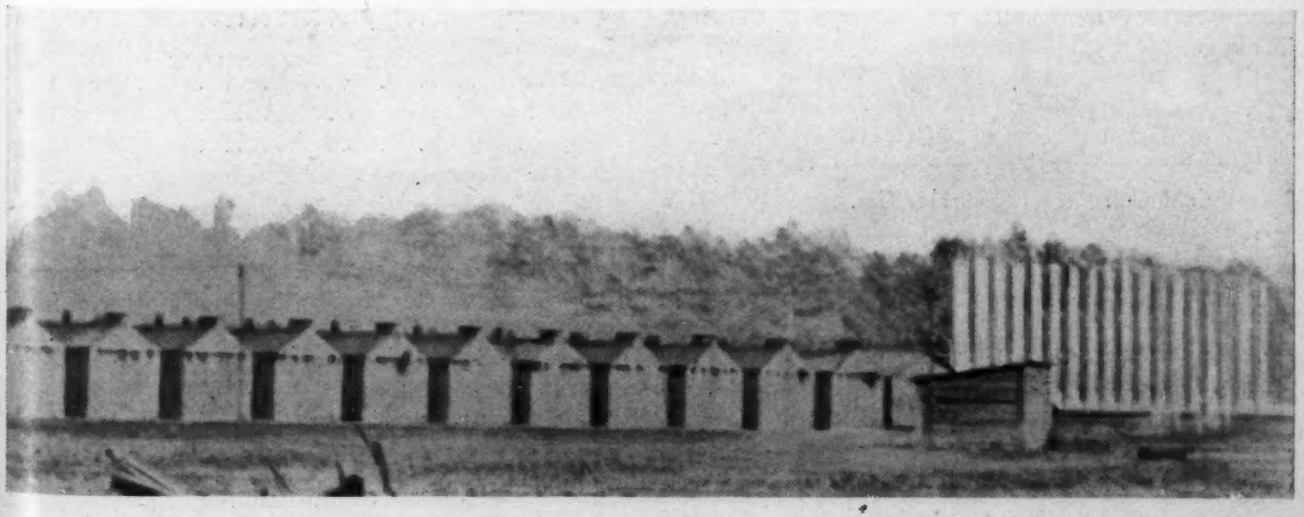
The manufacture of lampblack involves some interesting steps. It is produced by the smudge process and derived principally from coal tar oils, such as "dead" or creosote, which contains naphthalene in large amounts, smaller proportions of phenol and various other aromatic hydrocarbons which are particularly adapted to the production of lampblack by virtue of their large percentage of carbon. Certain work has been done in the production of lampblacks from waste polymers in the refining industry. When such products are burned in insufficient air there is obtained in the form of lampblack in suitably arranged chambers from 15 to 40 per cent by weight of the oil burned. The usual proceedure is to allow the oil to flow in a sluggish stream into an earthenware or metallic pot or pan, in which it burns and from which the smoke passes through flues into the chambers where the black is deposited.

PRODUCTION PRICE AND DISTRIBUTION

The first record of carbon black marketing reports a lot of 500 pounds which was manufactured at the New Cumberland, West Virginia plant in 1872, and which sold for $2.50 per pound. The next 1000 pounds sold for $1.50 per pound and the plant paid for itself in three months. By the year 1881 the price had fallen to 35 cents per pound; in 1882, to 31 cents, 1883 to 24 cents, and during the next 10 years the average price was 12 cents. From 1891 to 1906 the average price was six cents, and by 1912 the price had reached the low level of five cents per pound.

About the beginning of the present century, carbon black had practically replaced lampblack in the printing ink industry as it became a necessary ingredient of the inks required for modern high speed presses. However, the increase in production of carbon black during the past 40 years has been due, principally to new uses and to increased use in present applications rather than to replacement of other pigments.

Prior to 1915, carbon black was used in rubber only for coloring purposes and only in small amounts. Upon the discovery of its effect as a reinforcing agent in 1915, the growth of consumption was enormous so that from 1917 to 1923 production could not keep abreast of demand, and at the beginning of 1923 there



was an acute shortage of the product. From the first black produced in 1872 to the present time the industry has grown with rapid strides, especially since the time of its extensive use by the rubber industry. From a few million pounds in 1915 which production was used in the manufacture of inks and paints, the industry has grown to 45,000,000 pounds in 1918; 186,000,000 pounds in 1924; 248,000,000 pounds in 1928, and the 1929 production was 366,442,000 pounds.

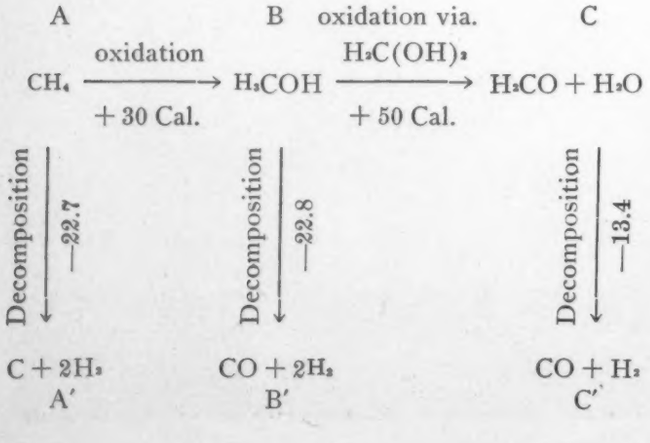
Based on past experience with the consuming industries it is estimated that the 1930 production was used as follows: 70 per cent in rubber, 13 per cent in ink, 10 per cent in paint, and seven per cent in miscellaneous applications. Thus the rubber industry alone consumed 122,500 tons of carbon black last year with the demand by the ink and paint trades aggregating 40,259 tons.

The remaining seven per cent is employed for a variety of uses by a number of industries. Included in this list there are such items as paint, varnish and mortar color, paper, paper board, vulcanized fibre, phenolic condensation products, carbon copying paper, stove and shoe polish, phonograph records, leather finishing, linoleum, crayons, artificial leather, India inks, artificial stone and tile and as an explosive in conjunction with liquid oxygen.

Of the total consumption of carbon black 72 to 75 per cent is utilized in the United States with the remainder being exported mostly to England, with France, Germany and Canada following in importance as customers in the order named. There is no carbon black manufactured outside of the United States, according to available information. Lampblack is relatively cheaper in Europe than carbon black, because of the necessity of packing the black in wooden cases for export shipment, and the cost of ocean freightage. The American production is priced about three cents higher when delivered in Europe.

PHYSICAL AND CHEMICAL PROPERTIES

Carbon black is produced from natural gas by thermal decomposition according to the following equation; (burning methane in an atmosphere deficient in oxygen)—



This decomposition or oxidation is referred to as hydroxylation. The amount of each step taking place is based on the amount of oxygen present which controls the equilibrium of each step in the oxidation, also the temperature of the flame. Only in the inner part of the flame is the temperature sufficient to effect the reaction A to A'. The per cent of oxygen necessary for the combustion of methane is 15.6 per cent which is the lower limit.

The heat generated by the reaction B and C causes reaction A to take place. The temperature of the flame is approximately 820° C. and the temperature of the channels is approximately 500° to 600° C. The actual temperature of the particles in the central part of the flame is probably higher than 820° C. The information as presented in the last three paragraphs concerning the reaction discussed is excerpted from a paper presented by W. F. Fulton, chemical engineer, The Palmer Corporation, at a meeting of the local Shreveport chapter of the American Chemical Society, Feb. 17, 1930. His work agrees with the technology of other investigators as published elsewhere. (See Bibliography accompanying part two of this writing.)

PHYSICAL AND CHEMICAL PROPERTIES VARY

Carbon black that is high in volatile matter can be changed by heating it in different atmospheres of oxygen, air, and other gases which step gives it entirely different physical and chemical properties. The following is an example, of the ultimate analysis of a sample of carbon black before and after heating to 950° C., according to Fulton. (As received)—

Carbon	.95 Per Cent
Hydrogen	.85 Per Cent
Oxygen	4.15 Per Cent

After heating—

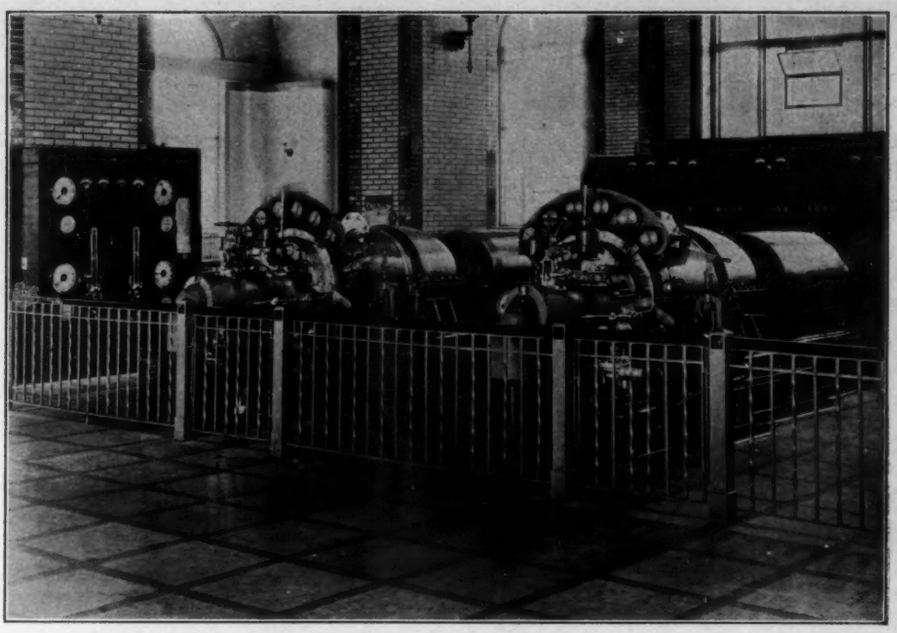
Carbon	.98 Per Cent
Hydrogen	.37 Per Cent
Oxygen	.73 Per Cent

Gases given off—

Carbon dioxide	—14.53 Per Cent
Illuminants	.16 Per Cent
Oxygen	1.15 Per Cent
Hydrogen	22.72 Per Cent
Carbon Monoxide	54.45 Per Cent
Ethane	.04 Per Cent
Methane	1.62 Per Cent
Nitrogen	5.33 Per Cent

The temperature of the flame governs the physical and chemical properties of the carbon black produced, to a great extent. Flames low in temperature result in black that is more active, high absorption of gases, high volatile matter, and with a lower percentage of total carbon. A flame higher in temperature causes the reverse, with lower volatile matter, less absorption of gas and higher percentage of total carbon. Such a condition is used advantageously in the manufacture of carbon black for use in the preparation of ink. which requires a black with high volatile matter

MOORE



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The Moore turbine generator units operate on steam at 300 lbs. pressure and 200° F. superheat, exhausting into 27″ vacuum. They automatically extract steam at pressures from 25 to 50 lbs. for heating and process. These units are representative of the class of equipment at Howard Bend, all of which was selected on the basis of established records for reliability and efficiency.

Our engineers are at your disposal to work out economies in your plant. There is no obligation.

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MOORE STEAM TURBINE CORP.

WELLSVILLE, N. Y.

and absorption of gas. This product is secured through the use of a burner tip with a round hole in the center and collecting the black on a cylindrical surface.

Heating likewise affects the absorption properties caused by a conglomeration of particles and burning the particles' surfaces by combination of oxygen absorbed by the carbon.

The increasing use of carbon black in rubber has brought about a set of standards which are set by the rubber companies. The product must be made to meet specifications as to low volatility, low absorption for sodium hydroxide and accelerators, to meet maximum tensile, elongation, abrasion to wear, requirements and also normal rate of curve. Blacks which have high volatility, high absorption and low total carbon which produces low tensile, elongation, and with slow curing, and which result in soft rubber, are classified as poor carbon blacks and are not acceptable for use in the rubber manufacturing trade.

BLACK GOVERNS RUBBER COMPOUND

Since proportions as high as 62 per cent of carbon black may be used in the compound base of the rubber, the physical properties of the black affect the physical properties of the rubber, it follows that the properties of the black are a governing factor in the final rubber compound. A good carbon black compounded in rubber up to 35 or 40 per cent by weight based on the rubber, should produce a final product with a tensile strength of 4500 pounds and 670 per cent elongation, with a hardness of 65 to 68 (Shore durometer) and good abrasion characteristics.

In further discussion of the physical properties of carbon blacks W. F. Fulton says, "When we take into consideration that the particles size of carbon black is approximately .15 microns (Ed. Note.—One micron equals one millionth part of one meter) and contains particles as small as .02 microns, which is of a colloidal size, any change in physical state will have an important effect upon the physical and chemical properties of the carbon as a whole.

"The properties of each particle, such as condition of surface, structure of surface, electrical charge of the particle, the degree of crystallization, are all affected by the condition under which the carbon is made. All of the above properties of the carbon have an important effect on the properties of any rubber compound in which it may be used. The chemical properties or analysis of carbon black do not show any definite relation to its properties in a rubber compound. Therefore we must look to the physical and colloidal properties of the carbon black to determine the properties it will give a rubber compound when it is vulcanized. In order to predict the properties of a finished rubber compound, using a certain carbon black, the type of compound must be known, the type of black, how made, physical and chemical properties in regard to type of rubber mix used, and final conditions of vulcanizing the compound after mixing; which means that quite a few variables are to be taken into consideration in determining the proper grade of carbon black to produce for use in different classes of rubber compounds. This discussion is given here primarily because of its interest, and also because the rubber industry is the largest customer of the carbon black industry and is rather exacting in its requirements.

REFINERS DISCUSS ECONOMIC SITUATION

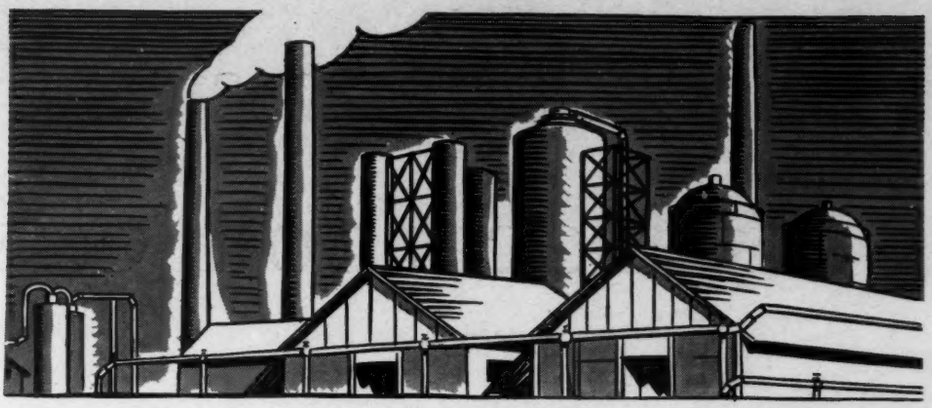
(*Continued from page* 68)

While committees were preparing reports, W. S. Fitzpatrick, chairman of the board of The Prairie Oil & Gas Company, was induced to speak briefly on the condition of the oil industry. He prefaced his remarks with a statement to the effect that the condition of his company had so changed that it would be forced to become competitive with some members of the association of refiners. "We believe," he said, "that there is room for individuals in business. A corporation would be governed by the rules that apply to the individual. When corporations fail to obey these rules, then it is time for the state to come in and police our conduct. Politicians would not bother business if business behaved itself. After floundering around as long as we have it does not seem proper for us to oppose some form of regulation. A majority is able to come to a common understanding and a minority usually spoils what the majority decided to do.

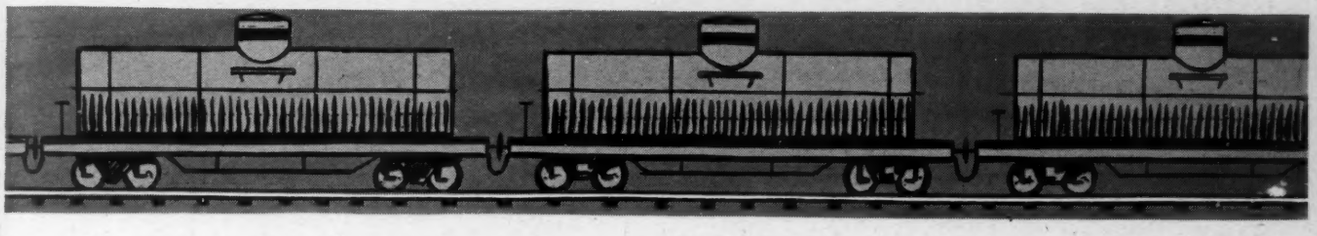
"If we are going to have pipe lines maintained as common carriers, and we should have, then we should have pipe line legislative protection similar to that enjoyed by the railroads. It is most important for us not to rely on codes but to set individual standards that are reasonable and then live up to them. The trouble with our codes has been that we have set up standards which we wanted others to live up to.

"Recently a banker told me that his legal adviser had given approval for certain action. When that banker was told that he might be going too far when he attempted to do all that his lawyer approved he seemed to resent it. I asked him why he did not call in his spiritual advisor in regard to the matter. That also did not get very far. But that is a good idea out here in the country and I believe it will work here. Let's try it."

All officials of the association were re-elected as follows: L. R. Crawford, Producers and Refiners Corporation, Independence, president; M. J. Grogan, Louisiana Oil Refining Corporation, Shreveport; George D. Locke, Barnsdall Refineries, Chicago, and E. H. Edleman, American Refining Properties, Wichita Falls, vice presidents. Reports from the technical committees on gasoline and lubricating oils were given by H. W. Camp and Dr. E. R. Lederer.



TURBO-EQUIPMENT



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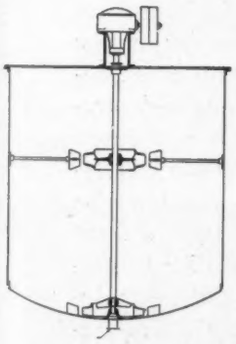

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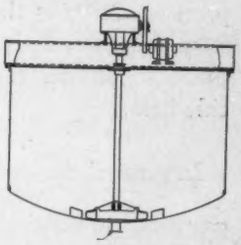

. . R E S U L T S . . . .

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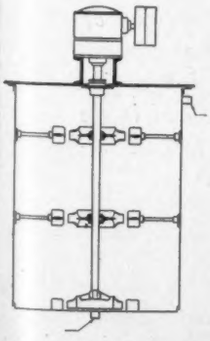

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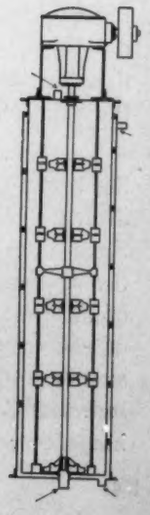

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The Compression Of Hydrocarbon Gases

PART II

By I. N. BEALL, *Chemical Engineer*

IN this article, which is part two of a series dealing with the compression of hydrocarbon gases, the discussion is centered around means of securing more efficient compressor operation, including condensing and non-condensing systems.

Mr. Beall presents some interesting conclusions having to do with calculation of the percentage liquefaction on compression, molal volumes of hydrocarbons, the importance of compression before condensation for certain types of oil absorption plants, compression at high pressures, and multiple stage compression.

The degree that a natural gas will deviate with pressure from the behavior of a perfect gas according to Boyle's law is determined by the relative proportion of each constituent. All gases become more compressible as the temperature is lowered. The deviations from Boyle's law and Charles law reach a maximum at equilibrium. Equations of state taking into acount the laws governing such deviations from the behavior of perfect gases will be presented in an article by Mr. Beall devoted to that important subject in the near future.

GAS pumping differs from liquid pumping in that a gas undergoes volume change. When a gas is compressed, unless heat is removed, the temperature rises. This temperature rise works in opposition to the efficiency of compression inasmuch as gases expand on heating, volumetric capacity being dependent upon final, as well as initial volumes. Inasmuch as all commercial compressors are either water or air cooled, the efficiency of compression lies somewhere between the isothermal and adiabatic. The rapidity of piston movement causes the actual condition to more nearly approach adiabatic. The exponent of the adiabatic compression curve is the ratio of the specific heat at constant pressure, Cp, to that at constant volume, Cv. The Cp is sometimes referred to as the instantaneous specific heat.

In general the $y = \frac{Cp}{Cv}$ values are nearly the same for gases the molecules of which contain an equal number of atoms. Thus the inert and monatomic gases such as helium, argon, mercury, etc. have gamma values of 1.667, the diatomic gases, oxygen, O_2, nitrogen, N_2, hydrogen, H_2, etc. have values of 1.40 to 1.41. Benzene, a 12 atom vapor, has a gamma value of 1.11 and ethyl ether $(C_2H_5)_2O$ with 15 atoms per mol $y = 1.06$. The foregoing values are those under nearly standard conditions of temperature and pressure, it being understood that variation of either temperature or pressure effect the value of gamma.

The actual exponent of the compression, curve which lies below that of strictly adiabatic compression, may be evaluated from the m.e.p. as found on an indicator card. Such engine indicators draw a diagram representing the pressures corresponding to the continuous positions of the piston during the stroke. The volumetric capacity of the cylinder with the position of the piston at full suction and full discharge should also be known. Such indicators are widely used for rating the indicated horsepower of internal combustion engines, but they are equally efficacious for the diagnosis of what is taking place in the gas compression cylinder.

The indicated horsepower on the compression piston, $\text{I.H.P.} = \frac{\text{m.e.p.}(\text{lan})}{33000}$ where m.e.p. = mean effective pressure in pounds per square foot, l = length of stroke

in feet, a = piston area in feet and n = number of strokes per minute, divided by the mechanical efficiency of the compressor is said to give the H.P. required in the combustion cylinder. If however, the total work of compression is considered to be the algebraic sum of the work of admission, compression and expulsion, the last two being of positive sign and the work of admission of negative sign, then there is something fundamentally wrong with the first assumption.

In other words the actual brake-horsepower, if easily obtainable, would be a better standard of compressor performance when compared with the m.e.p. card on the compression cylinder than the I.H.P. on the combustion cylinder. Inasmuch as large machines are not easily subjected to a brake test, other means for testing such as an accurately calibrated electric generator can be used and the current measured over a test period.

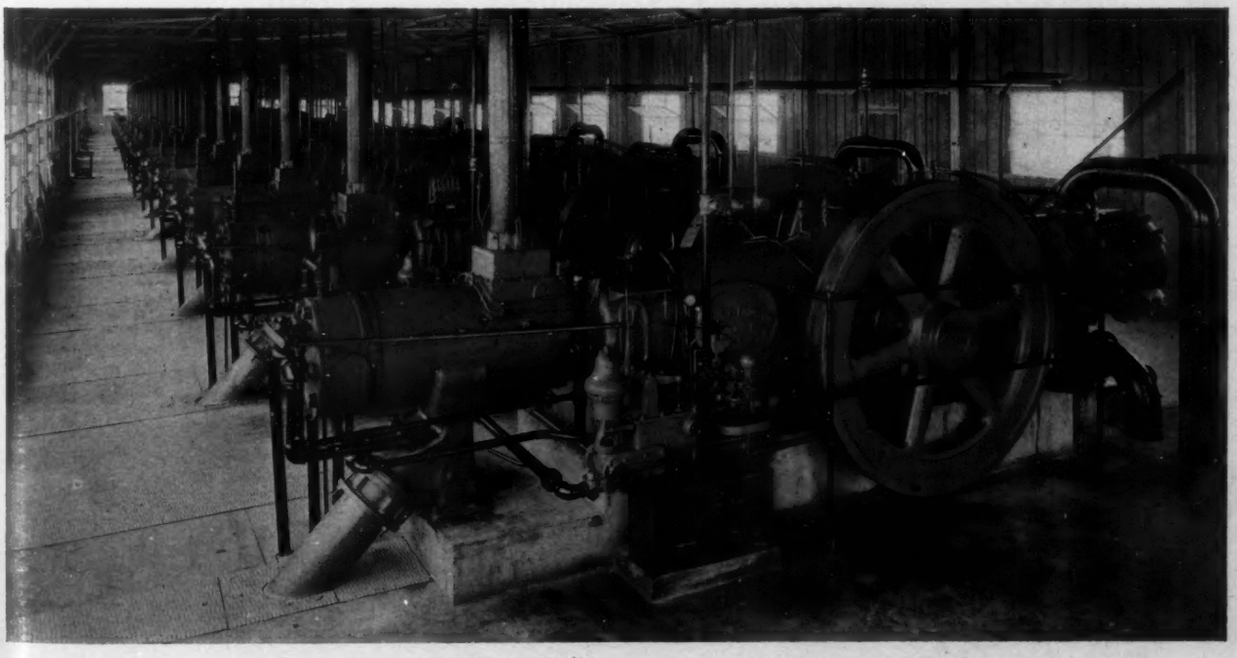
Getting back to the fundamental concept of work upon which H.P. is based, the work of admission is the actual volume in cubic feet at suction pressure and temperature multiplied by the actual absolute pressure in pounds per square foot = 144 x lbs./sq. in., the actual work of compression proper is the true m.e.p. value in lbs./sq. ft. x length of stroke in feet x area of piston in sq. ft = foot/pounds which divided by 33,000 gives the horsepower. The work of expulsion is the volume in cubic feet at discharge pressure and temperature times the absolute pressure. The calculations necessary to the analysis of compressor action for both isothermal and adiabatic compression were given in examples in a previous article on compression (*Ref. & N. G. M., Feb., 1931, page 99*). In addition to the above work requirements, the friction drop across both intake and discharge ports must be allowed. In actual practice the gas is never fully discharged because of the clearance and other space prior to the discharge port.

Natural gas compression may be classified as condensing and non-condensing. Usually the compression falls into an intermediate classification, namely that of a partially condensing system. For natural gas, compression serves two purposes, that of transportation and that for liquefaction. At times transportation may be paramount and liquefaction secondary, in other cases the reverse may hold, but as a rule, the two go hand in hand.

For natural gasoline plants interested in obtaining the maximum yields of natural gasoline or other liquefied hydrocarbon products, vapor compression studies are of particular value. Frequently, more can be accomplished in the way of condensation by the use of a moderately high single-stage compression than by two-stage using a lower first stage. This is because condensation depends on the average volatility of the mixture. If the low partial pressure constituents are removed by a primary stage of compression, the remaining uncondensed constituents may be of such high average volatility and partial pressure that no amount of pressure without excessive temperature reduction will condense.

An analogy exists between vapor compression and condensation, and fractional distillation. For efficiency of separation between constituents a greater number of distillations such as is performed by the successive plates in a fractionating column is desirable.

A great number of successively higher stages of compression with inter-condensation and inter-accumulation could accomplish results similar to fractional distillation, but there would be no comparison between the economies of operation between the two. For natural gasoline plants, the purposes of compression and fractionation are distinct. Compression serves either the purpose



A Modern Compression Plant, operating at 150 to 1500 pounds.

of condensation or transportation; it is the function of the fractionator to separate.

The writer has repeatedly stressed the importance of compression before condensation for certain types of oil absorption plants, and also the significance of high single-stage compression for effecting higher plant efficiencies. The key to high overall recovery is this: In order to thoroughly strip a gas, either high oil circulation or high pressures must be carried in the absorption step. This means a higher proportion of higher partial pressure constituents such as methane, ethane, propane and isobutane, as well as the heavier hydrocarbons. When this absorbed material is fractionated from the oil by the stripping columns, it must either be subjected to condensation under column pressure and the residue vapors compressed, or it may pass through a hot knock-out direct to compression. The latter condition is the one of maximum recovery. Such ideal conditions are complicated by the use of steam. Stripping with selected vapors is the solution to the problem.

The question has been asked, what will be the effect of such hot vapors entering the compression cylinder and undergoing compression? The answer is that no harm will result, a larger cylinder may be used because of the low ratio of specific heats $\frac{Cp}{Cv}$ which forms the exponent of the compression curves. This exponent also decreases with rise of temperature. Such vapors undergo very much higher volume change on compression than dry gases would under the same conditions of such suction and discharge.

It is to be remembered that volume changes in the neighborhood of equilibrium pressures are rather rapid, much more so than for dry gas or air. The effectiveness of any cooling operation such as that of the cylinder walls is dependent upon the temperature difference between the walls and the number of particles or molecules that impinge the surface.

CALCULATION OF THE PERCENTAGE LIQUEFACTION ON COMPRESSION

Murray (*"The Compression of Refinery and Casing-head Gases." Journ. Ind. & Eng. Chem. pp. 917-919, Oct., 1929*), has developed a method for predicting the amount of liquefaction that will take place on compression of hydrocarbon mixtures under given conditions. In all such calculations in the absence of more exact data on the molal volumes, the pound-mol of all gases is assumed to follow the perfect gas laws which is nearly the case at atmospheric pressure and at temperatures considerably above the boiling point. However, in the higher pressure range and at temperatures near the liquefaction point, molal volumes may be as low as one-fourth of that required by the gas laws. This, however, does not detract from the fact that this method offers an excellent insight into the mechanism of condensation, and for this reason is of practical importance.

Suppose for example it has been found from analysis that a stripping column vapor passing to compression has a composition: pentane, 30 per cent; isopentane, 20 per cent; butane, 25 per cent; isobutane, 15 per cent; propane, five per cent; ethane, three per cent; methane, two per cent.

TABLE 1

Temperature	60°F.		70°F.		80°F.		90°F.	
Name	V.P. lbs. sq. inch	V.P. X % / 100	V.P. lbs. sq. inch	V.P. X % / 100	V.P. lbs. sq. inch	V.P. X % / 100	V.P. lbs. sq. inch	V.P. X % / 100
Pentane	6.8	2.040	8.5	2.550	10.4	3.120	12.8	3.840
Isopentane	9.3	1.860	11.6	2.320	13.9	2.780	16.6	3.320
Butane	26.1	6.525	31.0	7.750	37.5	9.375	43.5	10.875
Isobutane	38.7	5.805	46.4	6.960	54.2	8.130	65.8	9.870
Propane	106.3	5.315	120.0	6.000	143.1	7.155	162.5	8.125
Ethane	475.0	14.250	512.0	15.360	557.0	16.710	645.0	19.350
Methane	3100.0	62.000	3550.0	67.000	3600.0	72.000	3825.0	77.50
Pressure for total condensation		97.795		107.940		119.27		132.93

In Table 1 the vapor pressures under the corresponding temperatures are lbs. abs. The partial pressures are found by multiplying the vapor pressures P_a, P_b, etc. by the mol fraction of pure constituent in the mixture. It will be noted that the pressure for total condensation is the sum of all the partial pressures and also expressed in pounds absolute. Pounds gauge are found by subtracting 14.7 from these values. The effect of temperature on the pressure required for total condensation is marked showing the importance of well cooled and temperature regulated condenser coils.

At 60°F., 83-lbs. gauge would suffice for total condensation, at 90°F., 118 lbs. would be required. It is obvious that if the temperature varies greatly the nature of the mixture going to the gasoline rectifying columns will be uniform in composition unless pres-

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sures are varied correspondingly. It is likewise apparent that a greater percentage of isobutane or butane in the gas mixture would lower the average partial pressure, and make condensation possible at lower pressures. Such is the case when such vapors are used to aid stripping to replace steam.

Suppose for example it is desired to predict what portions will condense at 80 pounds absolute 65 pounds gauge of the mix given in Table 1 at 80°F. Let P equal absolute discharge pressure. By the equation given by Murray:

$$\frac{A_L}{L} = \frac{A}{100\left(\frac{P_a}{P}K\right) + L\left[1-\left(\frac{P_a}{P}K\right)\right]}$$

A equals pound-mols of a pure component in the liquid.
So on for B, C.
L equals pounds-mols of liquid.
P_a, P_b, P_c, etc. equals vapor pressures of constituents.
K equals deviation constant of Raoults Law equals 0.85.

The reader is referred to the above mentioned article by Murray if further interested.

THE COMPRESSION RATIO

The general equation for determining the compression ratio is $\frac{\text{final pressure}}{\text{initial pressure}}$ equals $S^{\frac{s}{s-1}} = R_p =$ the compression ratio for maximum work. For isothermal compression, $S = 1$, $R_p = 2.72$. The formulas for methane, ethane, propane and butane for low pressures are approximately as shown in Table 2 for strictly adiabatic.

TABLE NO. II.—COMPRESSION RATIOS HYDROCARBONS

Temperature 77°F.

Name	S	$S \div (S-1)$	$S^{\frac{s}{s-1}} = R_p$	$1 \div S$	$(S-1) \div S$
Methane	1.28	4.57	3.09	0.787	0.218
Ethane	1.21	5.76	3.00	0.83	0.174
Propane	1.135	8.41	2.90	0.88	0.120
Butane	1.11	10.1	2.87	0.90	0.099
Isothermal	1.00		2.72	1.00	

Table 2 brings out how, with the ascension of the hydrocarbon series the conditions of compression proper approach the isothermal. In a previous article on this subject, a chart was given showing how the gamma or s values decrease on temperature increase. (*Ref. & N. G. M., Feb., 1931, page 99*).

From the values given in Table 2 the m.e.p. can be calculated from the equation given by Lucke:

$$\text{m.e.p.} = \frac{S}{S-1}\,(\text{Sup. PR})\left[1+C-C(R_p)^{\frac{1}{s}}\right]\left[(R_p)^{\frac{s-1}{s}}-1\right]$$

The work per cycle varies directly as the m.e.p. On the assumption of no clearance, the m.e.p. values as calculated from the values given in the equation are 3.1095 for methane and 3.0119 for ethane. Other values can be obtained by substituting the constants corresponding to the various hydrocarbons in the equation and solving for m.e.p. The adiabatic values of s in Table 2 can be corrected for cooling encountered under actual conditions, an approximate reduction of 15 per cent would perhaps give an average value. The volumes after compression, from which the work of expulsion can be calculated, can also be found from the use of such equations as were given in the former article on the subject.

MOLAL VOLUMES OF HYDROCARBONS

The utility of the mol-pound as a basic unit for engineering calculations insofar as such a unit applies to the natural gas and gasoline industries has been discussed and used throughout previous articles in this publication by the writer. In the absence of exact experimental data on the volumes of gases under various conditions of pressure and temperature, the molal volume is assumed to be 359 cubic feet at 32°F. and 1 atmosphere, corrections being applied for actual temperatures and pressures.

The molecular weight of the hydrocarbons increase within the series and with this increase the boiling points increase so that the pentanes are liquids at ordinary temperatures. The liquid molal volumes also increase with the ascension of the series. With the lower members such as methane the liquid volumes are insignificant as compared with the vapor volumes at atmospheric pressure and temperature. However, with the higher homologues, liquid volumes become appreciable when compared to vapor volumes, particularly at the higher pressures. The work exerted by the expansion of a liquid to a vapor and the reverse process of condensation from vapor to liquid is based on the relationship $PV^s =$ constant, in which the liquid volume is neglected. The more exact equation is P (Vapor Volume — Liquid Volume) = a constant.

TABLE NO. III.—LIQUID VAPOR VOLUMES OF HYDROCARBONS

60°F and 1 Atmosphere

	Methane	Ethane	Propane	Butane	Pentane	Hexane
1 lb. Liq. Vol. cu. ft.	0.044	0.038	0.030	0.029	0.025	0.024
1 lb. Liq. Vol. cu. ft.	0.444	0.038	0.030	0.029	0.025	0.024
Ratio $\frac{V_v}{V_L} = \frac{\text{Vapor Vol.}}{\text{Liquid Vol.}}$	535	331	286	222	210	184

The values in the table above are computed partly on a theoretical basis, but they serve to demonstrate how the ratio of vapor volume, V_v to the liquid volume V_l decreases. The incompressible portion of a gas is held to be as approximately four times that of the liquid volume. Curves based on the $P(\Delta V)$ constant are use-

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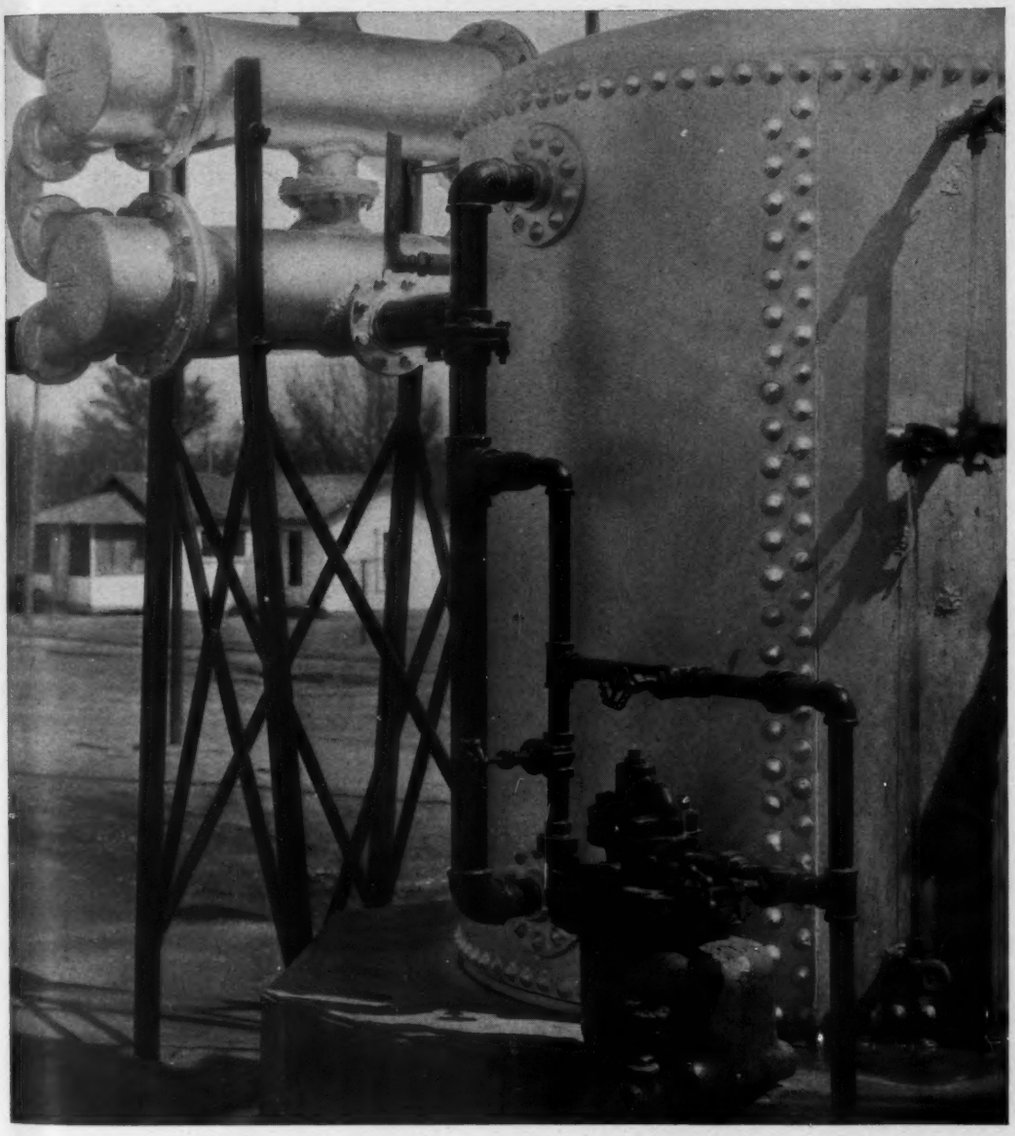

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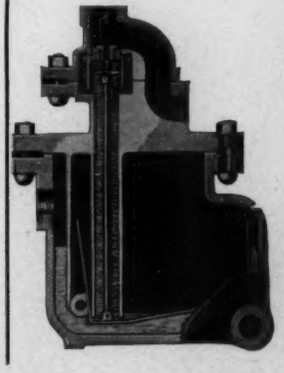

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ful for calculating the work required for the compression of wet vapors. The H. P. requirements for the change of state of 1 lb. from vapor to liquid will be $P(V_v - V_l)^s \div 33{,}000$ where P equals m.e.p. in pounds per square foot and V_v and V_l are the respective vapor and liquid volumes in cubic feet. Molal liquid and vapor volumes may be used in the above expression which would make the constant easier of application for some calculations.

Whenever the partial pressure of any component undergoing compression is in excess of the vapor pressure of that component at the temperature of compression, condensation will take place unless the compression temperature be above the critical temperature of the component. In case such condensation takes place in the compression cylinder most of it will be carried out with the exit gases in the form of a mist or spray. In cases where condensation is extremely heavy liquid may form on the cylinder walls and "cut" the lubrication, but there seems to be small evidence of such "cutting" even where condensation according to temperature or pressure would be heavy.

Evidently condensation that takes place on compression is in the form of exceedingly minute droplets. These droplets, if formed at the beginning of the stroke, which would seldom if ever be the case; for 200 r.p.m. less than 1/3 of a second. The rush and violent motion would keep these aggregates in suspension in the outlet gas. The practice of injecting a spray of liquid of similar composition to the vapor into a compression cylinder to effect cooling and reduce the work has its basis in the fact that the heat of compression is taken up by the liquid vaporization.

COMPRESSION AT HIGH PRESSURES

Gases at high pressures behave much the same as liquids. For ordinary temperatures, methane and ethane are the only two hydrocarbons of natural gas that have sufficiently low critical temperatures to permit high compression. However, when other gases higher in the series are admixed with either of these two gases, the average critical temperatures of the mixtures are raised. The pv values of the hydrocarbon gases pass through a minimum on pressure increase, and temperature effects this minimum value. The exponent of the compression curve becomes greater at the higher pressures, this tends to offset the effect of low pv values. The specific heat (Cp) at constant pressure is greater at the higher pressures. The Cv values also increase but not as fast in proportion as Cp.

More heat units are required to raise a pound of hydrocarbon gas through a given temperature rise at high pressure than at low pressure. The formulation of rigidly accurate laws for compression under all conditions of temperature and pressure awaits more accurate experimental results in the domain of specific heat. Outside of scattered information of a somewhat doubtful nature, there is little to be found on pressure as it effects the thermal heat capacities of the hydrocarbons.

NUMBER OF STAGES OF COMPRESSION

Compression is either single stage or multiple stage. When discussing the relative merits of single stage or multiple stage compression, the distinction between condensing and non-condensing gas systems must be held in mind. Compression, in other words, serves two purposes. The number of stages of compression depends upon which purpose is the objective, liquid recovery or gas transportation.

For every gas there exists an optimum condition for compression. The number of stages of compression found to give the maximum volumetric delivery for a given suction and discharge pressure per horsepower might not, if the gas is changed, be in the correct ratio. In general, it may be stated that the compression ratios are too high throughout the industry, more stages would effect appreciable savings in horsepower. Work requirements are at a minimum when the work of compression is equally divided between the cylinders. The larger the number of stages of compression with intercooling between stages, the more nearly do conditions approach the isothermal which is also a minimum work condition.

Air compression is a subject that has been well worked out for the reason that it is a gas of uniform composition and suction is taken usually at atmospheric pressure. Such is not the case with natural gas. The correct compression ratio to use is dependent upon the suction pressure and the physical characteristics of the mixture. The temperature of the gas entering the low stage suction may vary and with it the volume of the gas and its behavior on compression. All these variables change to some degree the exponent of the compression curve and with it the optimum ratio of compression.

The degree that a natural gas will deviate with pressure from the behavior of a perfect gas according to Boyle's law is determined by the relative proportion of each constituent. Most tables and graphs showing the compressibility of natural gas and its constituents do not state at what temperature the measurements were made. All gases are known to become more compressible as the temperature is lowered. The deviations from Boyles law and Charles law reach a maximum at equilibrium.

Equations of state taking into account the laws governing such deviations from the behavior of perfect gases will be given in a later article devoted to that subject. The working formulae upon which the accurate solution of natural gas compression problems depend are of themselves dependent upon the thermo-dynamic derivation of gas laws combining both simplicity and accuracy. It is frequently found expedient for purposes of ready application to sacrifice some of the ac-

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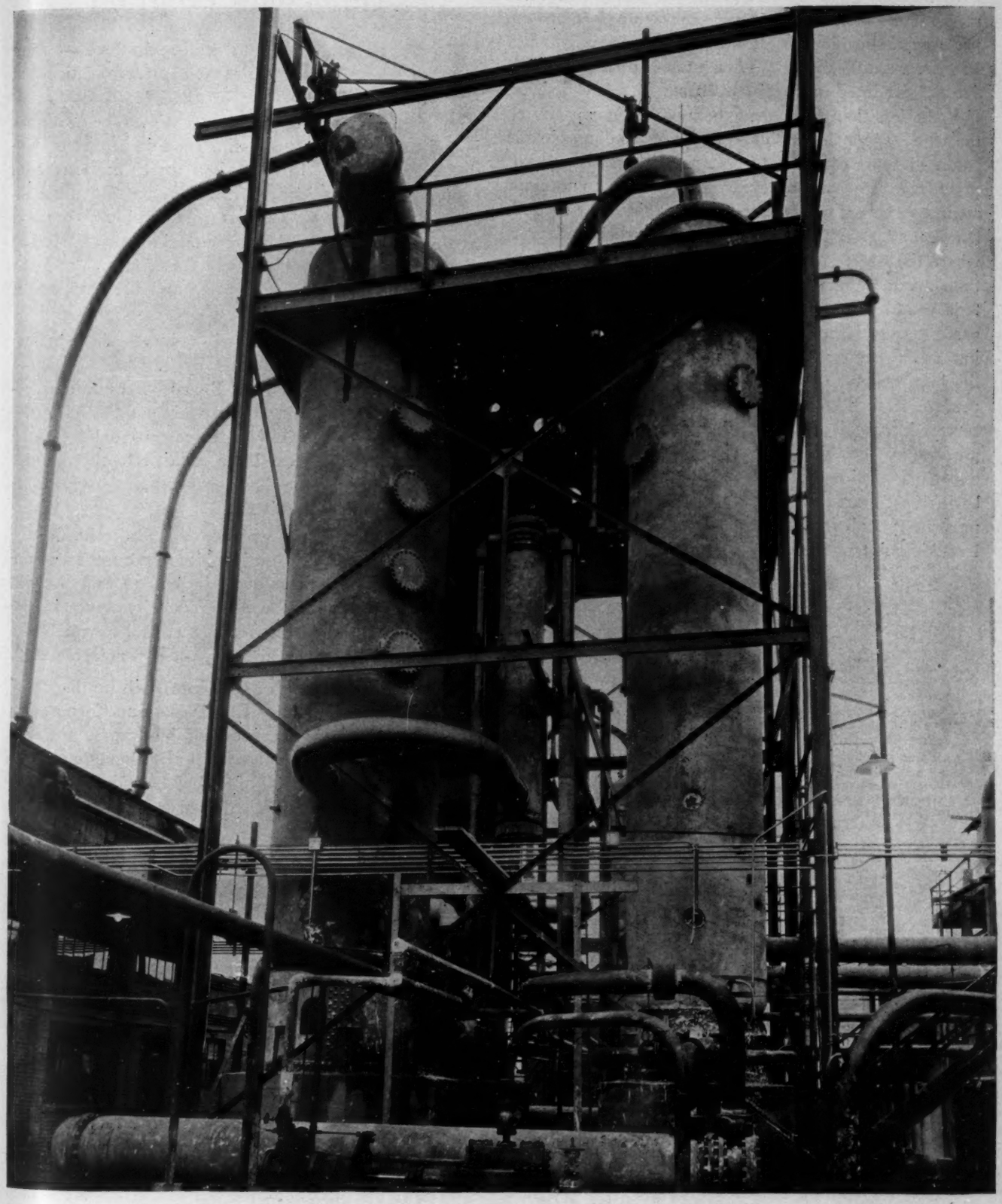

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curacy for the sake of simplicity of computation—the perfect gas laws are such an example.

In multi-stage compression, the horsepower requirements are determined among other things upon the pressure and volume of the gas entering the cylinder. In most cases $P_1V_1 = P_2V_2$ is assumed to be a constant for perfect inter-cooling between stages. If, however, P_2V_2 be less than P_1V_1 then the volumetric capacity of the high stage cylinder should be correspondingly less if balanced compression is to obtain. It is obviously impracticable to balance every multi-stage compressor against every set of conditions that might come up both before and after installation, but in large installations where the nature of the gas and other operating conditions are more or less established, attention to such details would result in power economy. The volume of gas entering a final stage of compression might be as low as 75 per cent of that required by theory,, while the low pressure cylinder had 100 per cent. With imperfect cooling between stages the situation might be reversed. Small changes in an exponential function produce appreciable changes in final calculations. The exponent of the compression curve which forms the basis of compression changes with both temperature and pressure, yet all formulae thus far evolved seem to neglect this point.

References to previous articles by I. N. Beall dealing with the practical application of technology and engineering data to the manufacture of gasoline, appearing in THE REFINER AND NATURAL GASOLINE MANUFACTURER:

Securing Maximum Recovery from Absorption Oils, March, 1930, page 70.

Adsorption and Absorption Oils, April, 1930, page 75.

Factors Affecting Operation of Absorption Equipment, May, 1930, page 88.

Design and Operation of Fractionating Columns, June, 1930, page 86.

Fractionation of Absorption Oils, July, 1930, page 88.

Fractionation for Absorption Plants, November, 1930, page 86.

Rectification of Natural Gas Hydrocarbons, Part 1, December, 1930, page 67.

Rectification of Natural Gas Hydrocarbons, Part 2, January, 1931, page 110.

The Compression of Hydrocarbon Gases, Part 1, February, 1931, page 99.

The Compression of Hydrocarbon Gases, Part 2, this issue.

R. J. S. Pigott, chairman of the Fluid Meters Committee, American Society of Mechanical Engineers, will give an address before the eighth annual Southwestern Gas Measurement Short Course, to be held April 21, 22 and 23, at the University of Oklahoma, Norman, Oklahoma. Mr. Pigott, who is in the research department of the Gulf Company at Pittsburgh, Pennsylvania, headed a group of engineers from the A. S. M. E. on a visit to last year's course. E. F. McKay, chairman of the 1931 registration committee for the school, in commenting on last year's school, said: "As a result of the attendance of the A. S. M. E. group, a close working relationship between the natural gas industry and the general subject of fluids metering has been established through the gas measurement course."

National Petroleum Association Announces Program

THE program for the semi-annual convention of the National Petroleum Association at Cleveland, Ohio, April 23 and 24, at the Cleveland Hotel, was announced recently. The program is indicative of an interesting and instructive two-day meet and will include such topics as petroleum economics, the anti-knock rating of gasoline, specifications of petroleum products, the problem common to the automotive and petroleum industries, studies of the marketing conditions in this country, and the mutual problems of the railroad and the shippers of oil and its products.

President E. M. Lyons will address the opening session and will be followed by J. Elmer Thomas, chairman of the Federal Oil Board's Economic Committee who will speak on economic conditions in the petroleum industry. It is pointed out that by April 1, much data will be at hand relative to the manner in which the industry has followed the suggestions of the economic committee.

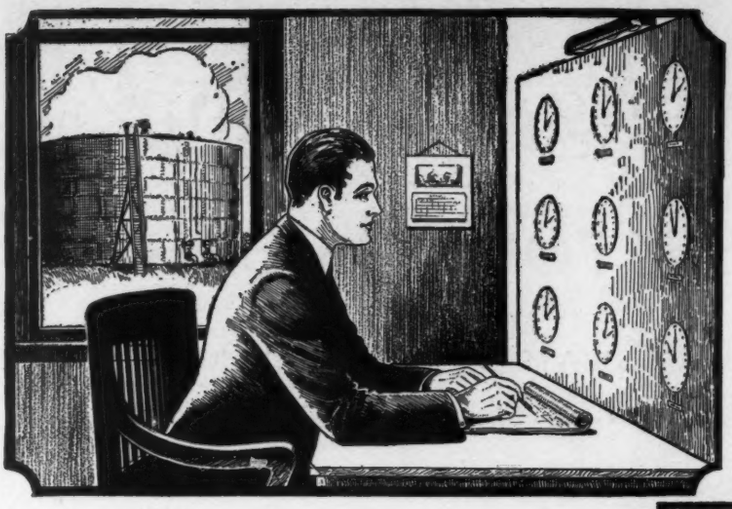
H. L. Horning, President of Waukesha Motor Company will speak on problems common to the automotive and petroleum industries and he will deal especially with the newer developments in the automotive industry and the means by which the petroleum industry is meeting new requirements.

"Anti-knock Rating of Gasoline" will be discussed by Earl Bartholomew of Ethyl Gasoline Corporation and director of the engineering laboratory for that company. He will deal with both the commercial aspects of the progress of Ethyl Gasoline Corporation as well as the technical phases of his subject.

Dr. H. C. Dickinson of the Bureau of Standards will discuss "Problems Involved in the Government's Purchases of Petroleum Products." A synopsis of his remarks will be submitted in advance of the meeting for discussion by executives and technologists who are interested in the practical and commercial aspects of petroleum specifications.

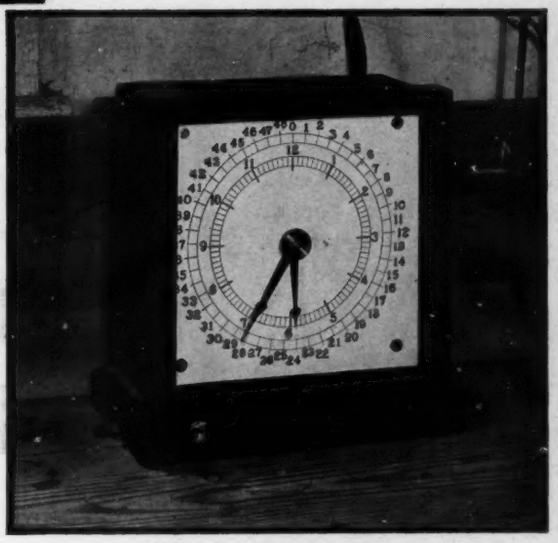
A study of marketing conditions in the petroleum industry will be presented by L. V. Nicholas. Julian L. Eysmans, vice-president in charge of traffic, Pennsylvania Railroad, will address the convention on "The Railroads and Their Competitors," speaking from the standpoint of the railroads. Willis Crane, traffic attorney for the National Petroleum Association will discuss the same subject from the standpoint of the shippers of petroleum and its products.

The annual Fellowship supper will be as informal as usual with no speeches or professional talent employed. Fred G. Clark, chairman of the entertainment committee will be in charge.



Miles Away

yet he can tell the fluid level just by glancing at the dial



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ARTICLE 3

Safeguarding Cracking Operations From Accident

By E. M. MATSON
Service Department, Universal Oil Products Company

This is the third in a series of articles by Mr. Matson on safety in cracking. The previous article, printed in the February issue, started a discussion of water, which is finished in this article.

Article 4, in the April issue, will deal with cracking hazards connected with corrosion of equipment.

A POUND of gunpowder contains a lot of energy. Everybody knows that. But not everybody knows that a cubic foot of water, heated to its boiling point under a pressure of 60 to 70 pounds contains just about as much. Steam engineers estimate that this is true.[1]

Consider, then, the force exerted if that same cubic foot of water were flashed into steam at the operating pressure and temperature of a cracking unit which may range from 150 to 1000 pounds pressure and from 750 to 1000°F.

Modern cracking equipment is designed to withstand the operating pressures and temperatures imposed with a high factor of safety but it is not and cannot be designed to stand the sudden tremendous shocks that may be thrown upon it by the introduction of slugs of water.

The sudden vaporization of a slug of water produces a violent shock. Following the initial impulse, the pressure rise is transmitted throughout the system provided this impulse did not produce local failure.

Safety valves mean little in such a case. The pressure rise is too sudden and violent. If the shock does not cause an immediate rupture, it may have a weakening effect, thus making the equipment more likely to fail during later operations.

To illustrate specifically the pressure rise due to the sudden introduction of water to a cracking plant, let us determine the amount of water which will produce a pressure increment of say 400 pounds in a primary tower being operated at certain stated conditions.

The size of this tower will be five feet by 40 feet with a vapor space equivalent to 80 per cent of the total volume.

The operating pressure (gauge) will be 200 pounds, and the temperature to which the water is raised, 700°F. The method of arriving at the result is illustrated below:

Maximum temperature in tower ..... 700°F.
Operating pressure. 200 Lbs.
Vapor volume—0.785 x 25 x 40 x 0.80..... 628 Cu. Ft.
Increase in pressure due to water ..... 400 Lbs.
Final pressure ..... 600 Lbs.
Specific volume of saturated steam..... 1.17 Cu. Ft.
Temp. of saturated steam @ 400 pounds.. 445°
Absolute temp.—445 + 460 ..... 905°
Final temp. absolute 1160

$$\text{Sp. vol. Superheated steam } \frac{1160}{905} \times 1.17 \ldots 1.50$$

$$\text{Cubic feet steam } \frac{400}{615} \times 628 \ldots 408$$

$$\text{Pounds of water } \frac{408}{1.50} \ldots 272$$

$$\text{Gallons of water } \frac{272}{8.33} \ldots 32.6$$

In this instance, a slug of water, 32½ gallons, will give an increase in pressure of 400 pounds, the resulting final pressure being 600 pounds.

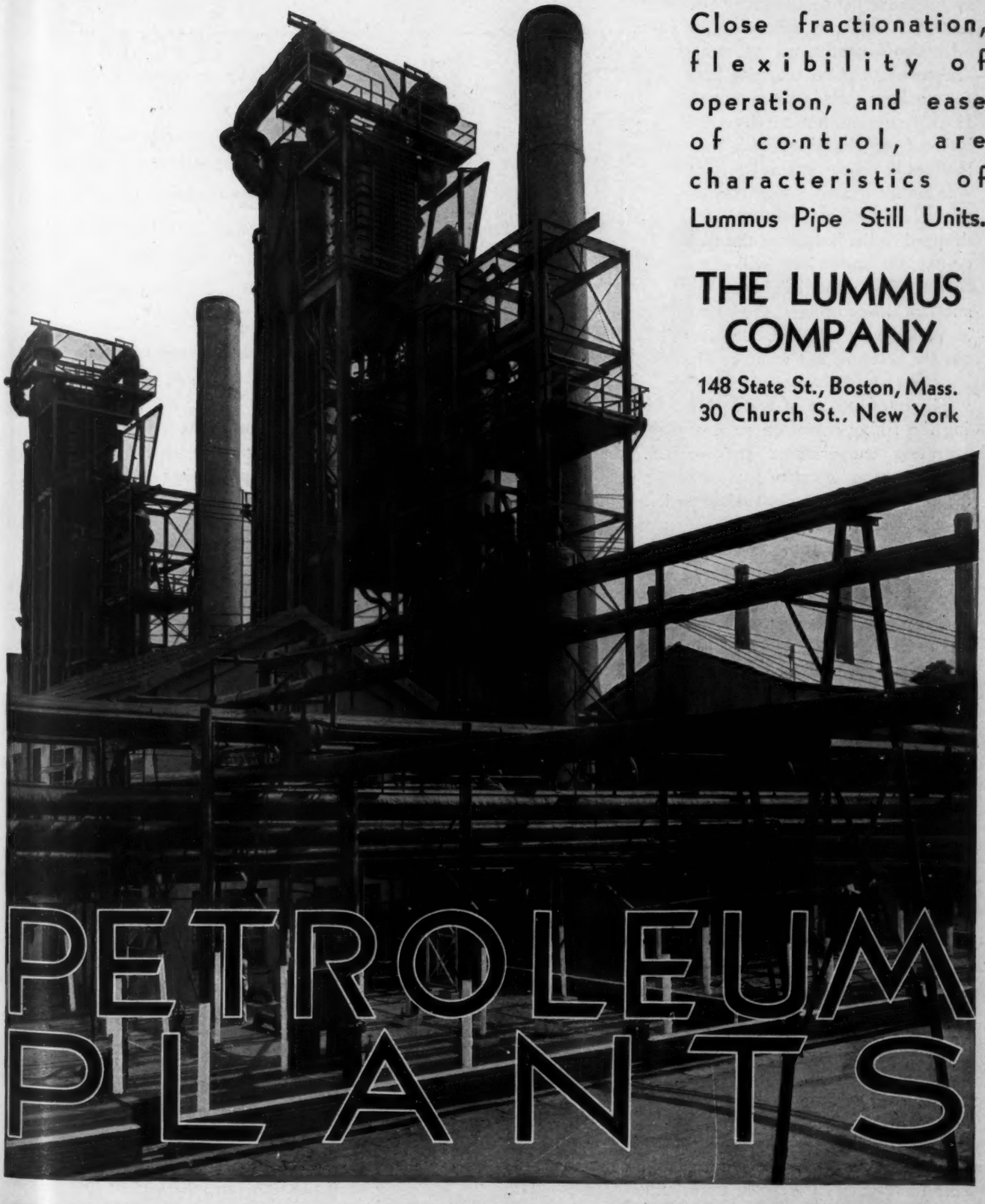
The maximum pressure thus built up is equivalent to three times the regular operating pressure. It is quite common in the design of cracking plant vessels to use the safety factor of three based on an ultimate stress determined by long time temperature tests. Thus, in the instance cited, the pressure exerted has developed the ultimate stress of the steel.

Aside from the actual pressure developed, we have another factor which enters into the picture, and that is the shock or impulse in the tower.

While there are many ways for water to enter a cracking unit, probably the most dangerous possibility

[1] "Steam," Babcock & Wilcox, 36th Edition, 1923, page 45.

LUMMUS



Close fractionation, flexibility of operation, and ease of control, are characteristics of Lummus Pipe Still Units.

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is that water may be pumped direct into the unit from the accumulated layer in the bottom of the charging stock tank, particularly where swing line connections are used.

This can occur through dropping of the swing pipe opening into the water through failure of pipe or cable due to corrosion or through carelessness. Leaks in swing line or connections may also let water into the unit with the oil. Consequently, use of swing line connections on charging lines for cracking units is not approved. It is dangerous not to clean the b.s. out of charging stock tank bottoms at proper intervals.

Whether a swing line connection is used or not, whether it is dropped to the bottom of the tank or not, the water level will eventually rise to the height of the suction line unless the tank is periodically cleaned. Draining out the water is not enough. The b.s. must also be removed.

The introduction of water during the filling operation or at any time before normal operating temperatures are reached, has also been pointed out as a source of hazard. This arises out of the possibility of its becoming pocketed in low points of the system through failure to drain it during the early stages of a run.

The danger element in pocketed water is that as temperatures finally do reach the boiling point of water and vaporization begins, convection currents are set up in the hot oil and a turbulent action takes place. Prior to this period, heat transfer downward through the oil body may have been only by conduction, which is indeed relatively slow.

As the oil body is stirred up by the initial water vaporization, hot oil is rapidly contacted with the water and as a result, vaporization then proceeds very rapidly. It is, of course, accompanied by pressure rise.

It may be interesting to determine the amount of water which will produce various pressure increments when suddenly vaporized in a large reaction drum.

Consider for this purpose an eight-foot by 40-foot vessel, one quarter full of oil and with vapor in the balance of the drum at a temperature of 750°F., the final temperature, after the water and relatively cool oil in the chamber has been contacted with the hotter vapors due to sudden disturbance of oil, water and vapor being 700°F.

The initial pressure in this case will be taken at 200 pounds. The results obtained are as indicated in the accompanying table:[2]

The amounts of water required to bring about pressure increases in a reaction drum under certain operating conditions are of interest in connection with this subject, as they impress one with the potential hazard through failure to take proper precautions against its elimination from the cracking process.

The danger hazard is greatest in connection with large vessels rather than piping, due to the greater volume of hot oil and vapors suddenly made free if a rupture occurs. The sudden release of the latent energy produces an explosive effort. The violent wave movement and concussion spreads destruction in its path. The ignition of the hot vapor follows. Fire then takes its toll along with the explosion.

Increase in Pressure	Sp. Vol. Sat. Steam Cu. Ft./Lb.	Temp. Sat. Steam °F.	Temp. Sat. Steam °Abs.	Final Temp. °Abs.	T_2 V. / T. Cu. ft./Lb.	Cu. Ft. Steam	Pounds H_2O	Gals. H_2O	% Water of total chamber vol.
100	4.43	328	788	1160	6.53	476	72.9	8.7	.078
200	2.29	382	842	1160	3.15	726	230	27.6	.245
300	1.55	418	878	1160	2.05	878	428	51.4	.456
400	1.17	445	905	1160	1.50	980	653	78.3	.698

Oil Vapor at 700°F. and 200 lbs./sq. in.

$\frac{215}{315} \times 1506 =$ 1030 cu. ft. oil vapor
476 cu. ft. steam

$\frac{215}{415} \times 1506 =$ 780 cu. ft. oil vapor
726 cu. ft. steam

$\frac{215}{515} \times 1506 =$ 628 cu. ft. oil vapor
878 cu. ft. steam

$\frac{215}{615} \times 1506 =$ 526 cu. ft. oil vapor
980 cu. ft steam

[2]In the method of calculation used, we have considered only iso-thermal expansion. It was not deemed necessary to use the principle of adiabatic expansion.

RULES FOR AVOIDING WATER

Below are listed a number of steps which experience has shown to be effective in keeping water out of the cracking system.

1. Install at least two charging stock tanks, each having a capacity equal to at least a 72-hour supply.

2. Charge no stock to a unit until it has settled at least 24 hours and the tanks have been thieved and drained. Use standard thief.

3. Open water drain valve not more than one-quarter of full opening to avoid funneling or vortex action.

4. Do not contaminate charging stock with slops, skimmings or other water-laden oils.

5. Settle all charging stock from foreign plants for at least 24 hours before being delivered to the cracking charging stock tank.

6. Thief and drain settling tanks before transferring to the cracking charging stock tanks.

7. Pump no stock into a stock tank from which units are being charged.

8. Recirculate from a unit being placed in service to a special recirculation stock tank and not to the regular charging stock tanks.

9. Keep roofs on charging stock tanks water-tight. Keep manhole and gaugehole hatches closed. Suction to charging pumps shall be an independent line, suction connection entering side of tank at least four feet from

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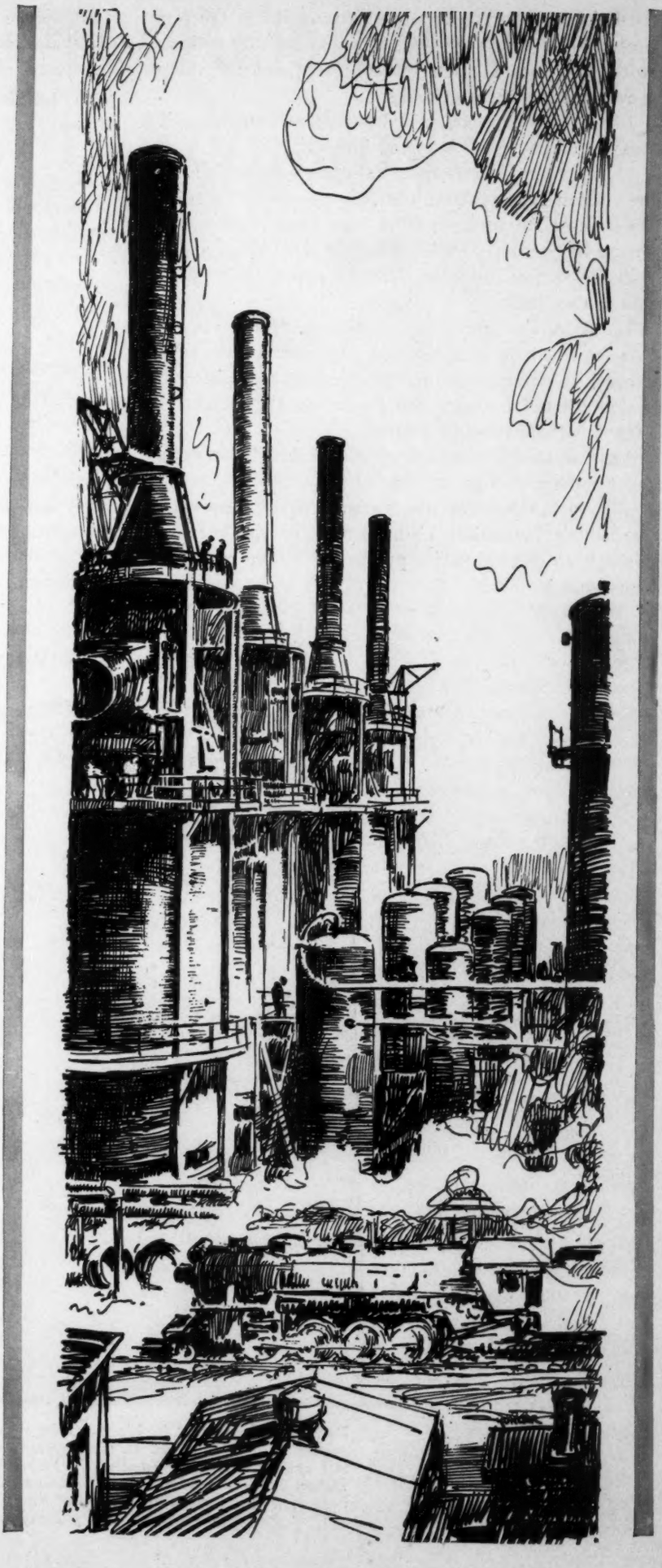

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the bottom and without any extension inside the tank. Steam coil for heating shall be made up well and provided with substantial supports at frequent intervals to prevent development of leaks.

10. Drain steam coil and draw water from charging stock tanks at frequent stated intervals.

11. Suction connection for ram pump should be from the suction header of the charging pumps. If a special stock must be used for the ram pump, the suction should be connected as for charging stock tanks and the same inspection and supervision be applied to such ram pump stock tanks.

12. After an emergency shutdown, if the unit has been steamed or water cooled, and operation then resumed, the same procedure with respect to draining the system should be employed as during the starting up after a regular run and cleanout.

13. Condenser and cooler coils should be examined for tightness during each run.

14. An independent filling pump should be provided for filling the unit. (Using filling pumps for other services or general utility pumps for filling may prove dangerous.)

15. Surge lines of surge type hot oil pump should be drained after charging at hourly intervals until unit is on stream.

16. Emulsified stocks running 1.0 per cent or more of water content must be dehydrated before charged to unit.

17. When the accumulation of b.s. in charging stock tanks reaches a height of not more than 18 inches the tank should be cleaned. (Suction connection 48 inches above floor of tank.)

18. That if the overhead product is recirculated back to the system for temperature control, the connection to the tank from which it is drawn be independent of the regular suction connection and be located at a point six inches or more above it.

19. The cracking plant overhead product receiver should be watched for water and if necessary drained every hour.

20. All water connections to the plant should be disconnected before charging a unit and all valves in steam connections to the unit should be inspected rigidly for condition and tightness each shut-down.

HEATH REFINERY SAFETY BOARD

Pure Oil Company at its Heath, Ohio, refinery, keeps the matter of safety before its employees with this board. All operatives are interested in the record of their organization and are inclined to help improve the plant's standing. News pictures (note Lindbergh who was big news at the time of this picture).

Gasoline—Its Relation to Petroleum Economics

Digest of paper read before Petroleum Section of American Institute of Mining and Metallurgical Engineers, New York Meeting, 1931

By H. J. STRUTH
Staff Economist

IN these trying times of proration and low oil prices, it is decidedly necessary for all branches of the petroleum industry to accord full recognition to the economic phenomena that contribute to its varying state of welfare. Perhaps no other single factor has a more important bearing upon the general oil situation than the supply and demand of gasoline. Year after year, the records have shown that the degree of prosperity or depression accompanying the industry's developments has been to a large extent influenced by the degree of balance maintained between the supply and demand of gasoline.

Indicative of this is the fact that crude oil production was curtailed to the extent of 98,323,000 barrels last year, while refinery runs to stills were maintained at an excessive rate until late in the year, creating an excess gasoline production of 6,663,000 barrels above actual requirements. Nevertheless, the movement to curtail refinery operations during the closing months of the year prevented a far worse situation, although it came too late to turn the ebbing momentum of the general oil market.

Despite the severe depression of the market values that accompanied 1930 developments, it can be said that the results attained during the closing months of the year, in the direction of production control, marked a decisive turn in the industry's economic affairs. In fact, a review of the oil situation from every angle points definitely to a better general understanding and recognition of the workings of the economic law of supply and demand. As a result, the year closed with crude production in theoretical balance with market requirements, while refinery runs had been curtailed to the extent of reducing an earlier indicated excess of about 83,000,000 barrels to an actual excess of but 16,000,000 barrels. The records of crude oil production in the United States point to an almost uninterrupted downward trend during 1930, having prescribed a decline from the beginning to the end of that year of about 575,000 barrels daily. The evidence at hand also shows that refinery operations were conducted on a decidedly uneconomic basis. It is apparent, therefore, that the responsibility for the unsatisfactory situation during 1930 rests almost solely with the refiner.

—*Bachrach*

H. J. STRUTH

Elected vice-chairman for Economics of the Petroleum Divison, American Institute of Mining and Metallurgical Engineers

To effectively illustrate the relationship of gasoline supply and demand to the economic structure of the petroleum industry, the writer has constructed a graphic set-up (Figure 1) depicting the relative effect of economic and uneconomic refining operations, having for its foundation the demand for gasoline. What actually happened last year is forcefully illustrated by the indicated loss of $35,000,000; what might have happened under a strict economic program is amply recorded by an unrealized profit of $360,000,000. The net result of the composite picture is an economic loss to the industry of $395,000,000. It is seen, therefore, that the foundation of the petroleum industry's economic and financial structure rests upon the demand for gasoline and the degree with which refiners exercise control over the supply of that product.

While gasoline represents about 42.5 per cent of every barrel of crude refined, the revenue from the sale of this product constitutes 60.2 per cent of the gross income of the refining branch of the industry. This is graphically illustrated in Figure 2, which shows the approximate yield of products from a barrel of crude during 1930 and the proportionate revenue derived from product sales. Since gasoline represents not only the chief constituent

of crude oil but also the chief source of revenue to the refiner, it is obvious to conclude that economic control of the oil industry resolves itself, primarily, to control the gasoline supply. Therefore any constructive program of oil production control must begin with a definite knowledge of anticipated gasoline demand. With that as a basis, the industry can intelligently

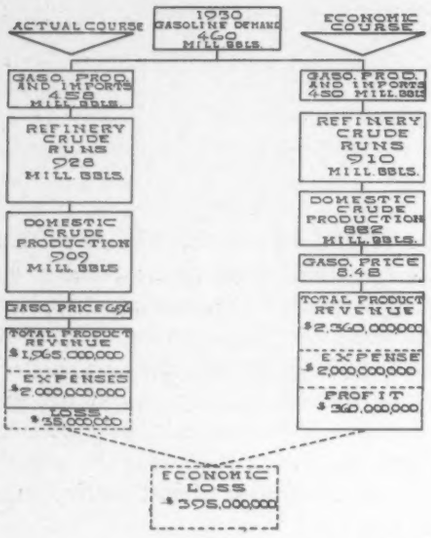
ACTUAL COURSE
1930 GASOLINE DEMAND 460 MILL BBLS.
ECONOMIC COURSE
GASO. PROD. AND IMPORTS 458 MILL BBLS.
REFINERY CRUDE RUNS 928 MILL BBLS.
DOMESTIC CRUDE PRODUCTION 909 MILL BBLS.
GASO. PRICE 6¢
TOTAL PRODUCT REVENUE $1,965,000,000
EXPENSES $2,000,000,000
LOSS $35,000,000
GASO. PROD. AND IMPORTS 450 MILL BBLS.
REFINERY CRUDE RUNS 910 MILL BBLS.
DOMESTIC CRUDE PRODUCTION 882 MILL BBLS.
GASO. PRICE 8.4¢
TOTAL PRODUCT REVENUE $2,360,000,000
EXPENSE $2,000,000,000
PROFIT $360,000,000
ECONOMIC LOSS $395,000,000

FIGURE 1

Relative effect of economic and uneconomic refining operations in 1930

project its operations on a sound basis that will prevent excessive processing of crude and, consequently, maintain a crude production level that will insure economic stability.

A careful survey of this year's gasoline requirements indicates that the total demand, including exports, will amount to about 478,345,000 barrels, a gain of 3.94 per cent over 1930. Domestic consumption is not expected to exceed 408,056,000 barrels, a gain of only 3.18 per cent over 1930, while exports are estimated at a total of 70,289,000 barrels, a gain of 7.65 per cent over last year.

This year's gasoline demand forecast is based upon a probable average motor vehicle registration of 27,650,000, assuming that the total registration on January 1, 1931, was about 26,800,000. On this basis refinery runs should not exceed 914,000,000 barrels of crude this year, and of that quantity only 854,000,000 barrels constituted domestic crude, since about 60,000,000 barrels of foreign crude will undoubtedly be run to stills.

Further analysis of the probable demand for gasoline during 1931 shows that about 346,435,000 barrels will be consumed by motor vehicles in the United States; 61,621,000 barrels will constitute miscellaneous domestic consumption and 70,289,000 barrels presumably will be diverted into foreign channels.

In order to illustrate fully the important function of gasoline in the economic structure of the petroleum industry, the writer has built up a complete itinerary of what he believes is a normal course for both refinery operations and domestic crude oil production this year. Table 1 shows how the demand for crude will probably be distributed on a monthly and quarterly basis, using as a foundation the normal refinery crude demand dictated by the demand for gasoline. The final step in this set-up, Table 2, is an allocation of the total crude demand to the various producing areas of the United States, and a suggested

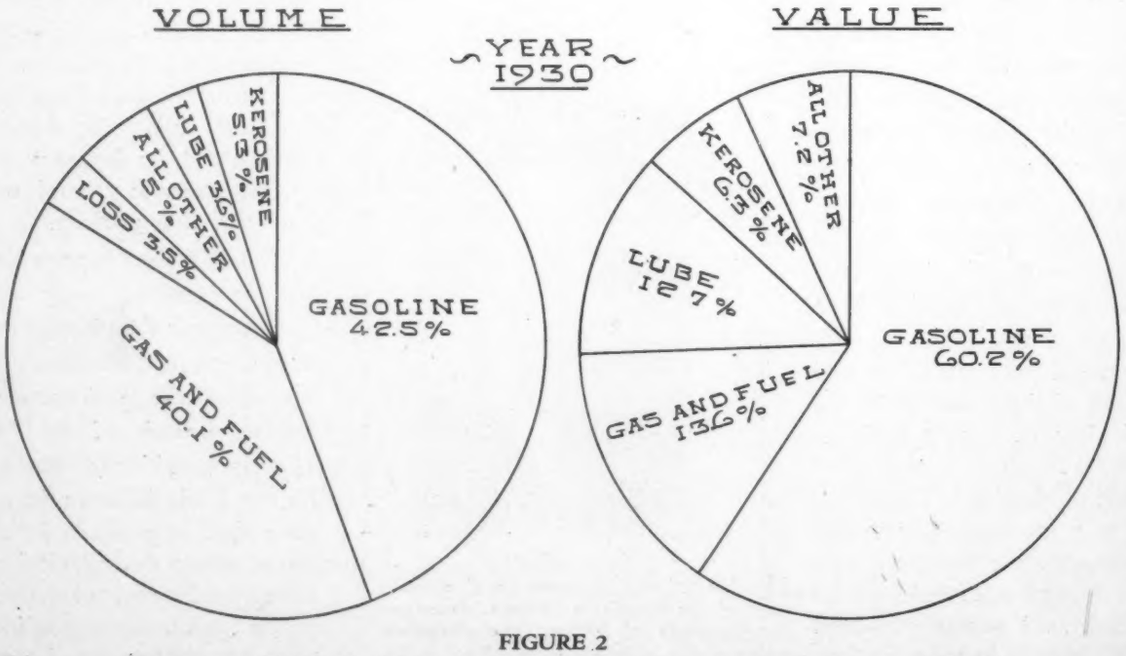

FIGURE 2

Percentage division of a barrel of crude in products, by volume and value; year 1930

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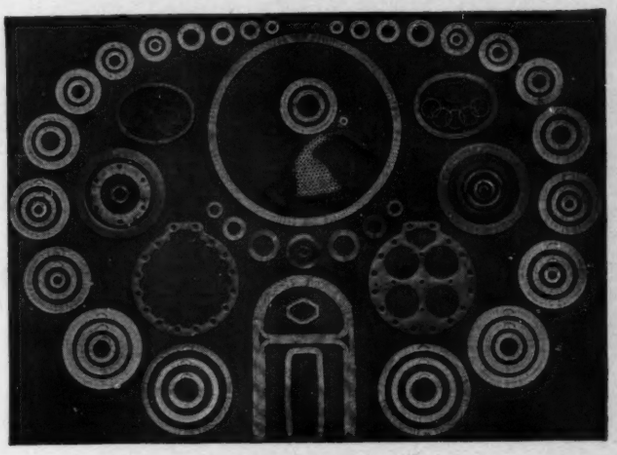

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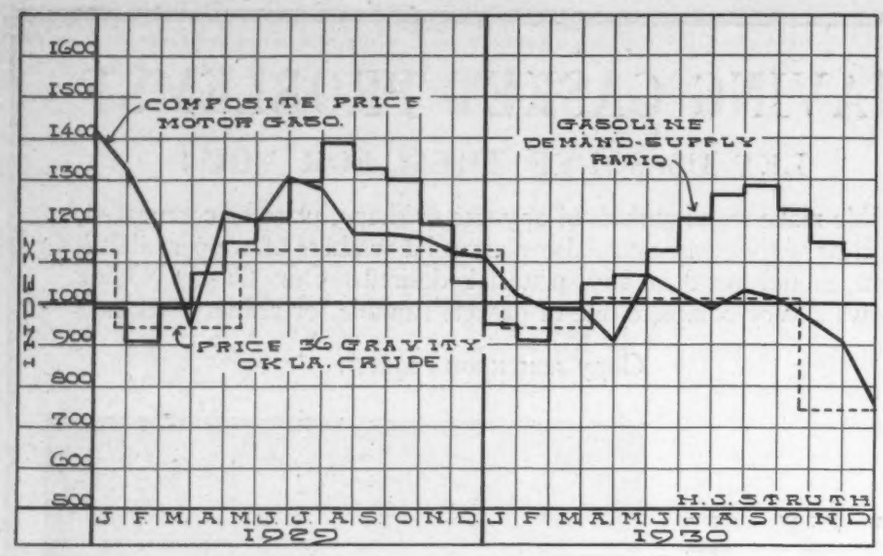

FIGURE 3

Trend of gasoline price in relation to its demand-supply ratio and posted price of crude

program of storage withdrawals, culminating in an economic crude production total and daily average for the respective regions.

TABLE 1.—BASIS FOR FIGURING DOMESTIC CRUDE DEMAND, 1931

Thousands of Barrels

	Total Refinery Demand	Foreign Crude	Dom'st Crude	Exports and Other	Total Dom'st Crude Required	Daily Average	Quarterly
January	68,334	4,730	63,604	2,010	65,614	2,117	
February	63,697	4,339	59,358	2,025	61,383	2,192	2,268
March	79,556	4,868	74,688	2,499	77,187	2,490	
April	73,645	4,848	68,797	2,124	70,921	2,364	
May	76,940	5,089	71,851	2,435	74,286	2,396	2,451
June	79,927	5,147	74,780	3,072	77,852	2,595	
July	84,079	5,199	78,880	2,761	81,641	2,634	
August	83,462	5,376	78,086	3,072	81,158	2,618	2,640
September	82,875	5,231	77,644	2,447	80,091	2,670	
October	76,029	5,252	70,777	3,294	74,071	2,389	
November	71,013	5,021	65,992	2,762	68,754	2,292	2,334
December	74,308	4,900	69,408	2,499	71,907	2,320	
Total	913,865	60,000	853,865	31,000	884,865	2,424	
Daily	2,504	164	2,340	84	2,424	....	

TABLE 2.—MAXIMUM PRODUCTION LIMIT TO EFFECT NORMAL REDUCTION IN CRUDE STOCKS, 1931

	Indicated Total Demand	Daily Average	Desired Stock Reduction	New Production Required	Daily Average
Arkansas	21,170,000	58,000	635,000	20,535,000	56,000
California	213,525,000	585,000	13,129,000	200,396,000	549,000
Kansas	42,705,000	117,000	1,814,000	40,891,000	112,000
Louisiana	28,470,000	78,000	907,000	27,563,000	76,000
Oklahoma	198,925,000	545,000	9,308,000	189,617,000	519,000
Texas	288,455,000	790,000	5,443,000	283,012,000	775,000
Balance U. S.	91,615,000	251,000	3,629,000	87,986,000	241,000
Total	884,865,000	2,424,000	34,865,000	850,000,000	2,328,000

It is obvious from the foregoing data that the demand for gasoline furnishes an ideal guide upon which to devise a well-rounded program of economic production control for the petroleum industry. As a matter of fact, had such a program been pursued effectively last year, the industry undoubtedly would have made a far better showing. At any rate, the market structure would not have shown the decided reactionary trend illustrated in Figure 3, which shows the course of the gasoline market in relation to the ratio of demand to supply and the posted price of crude oil.

If the efforts begun in the latter part of last year are continued throughout all of this year, the refining branch of the industry will project a course of operations that will somewhat conform to the course suggested in Figure 4. The solid line indicates the actual course of refinery still runs last year, while the broken line shows the rate at which crude should be run to stills this year, conforming to the indicated seasonal demand for gasoline. The shaded area shows how much runs to stills must be curtailed under the actual course of last year, while the solid black area indicates how much runs can exceed the curtailed operations of last year, provided that run schedules are not in excess of normal during the first six months.

That refiners have failed, miserably, in the past to maintain a normal supply of gasoline in storage is effectively shown in Figure 5. In terms of gallons per motor vehicle, a normal stock of gasoline during the present year contemplates an average per registration of about 60 gallons. Since 1921, there has been an indicated, necessary increase in the quantity of gasoline considered a normal reserve of from 46 gallons per vehicle to 62 gallons last year. In contrast with this is the actual course of gasoline stocks, ranging from 55 gallons in 1920 to a peak of 85 gallons in 1925. However, more attention has been given to this unwieldy situation since 1926, although the excesses of 1930 defeated previous efforts to reduce the abnormal stored supply of gasoline. It is evident, though, that increased consumption per motor vehicle has also played a part in correcting the unsatisfactory state of the gasoline storage situation, as indicated by the curve of consumption and its direct effect upon the normal course of stocks.

On the assumption that an approximate normal gasoline stock per motor vehicle constitutes a ratio of 1.2 stock to consumption, the writer finds that the mean average stock of gasoline during 1931 should be about 40,000,000 barrels. In conformity with the indicated seasonal demand, this indicates a minimum stock, following the season of peak demand, of 34,000,000 barrels and a maximum, as of about April 1, of 47,000,000 barrels. In arriving at this conclusion it was assumed that 1928 was a near-normal year; at least to the extent where stocks per

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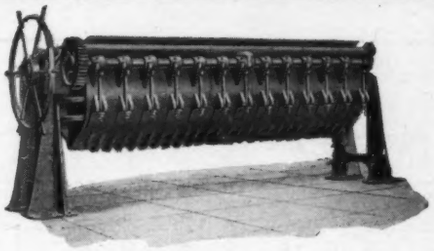

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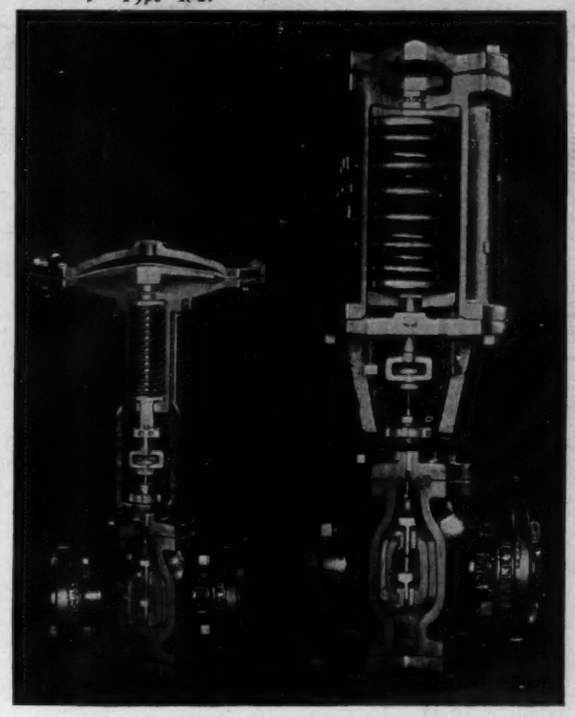
Unretouched photograph of Wilgus Direct Actuated Reducing Regulator cut away to show construction. Left, 2" Type R-1. Right, 3" Type R-2.



TO THE OIL INDUSTRY »

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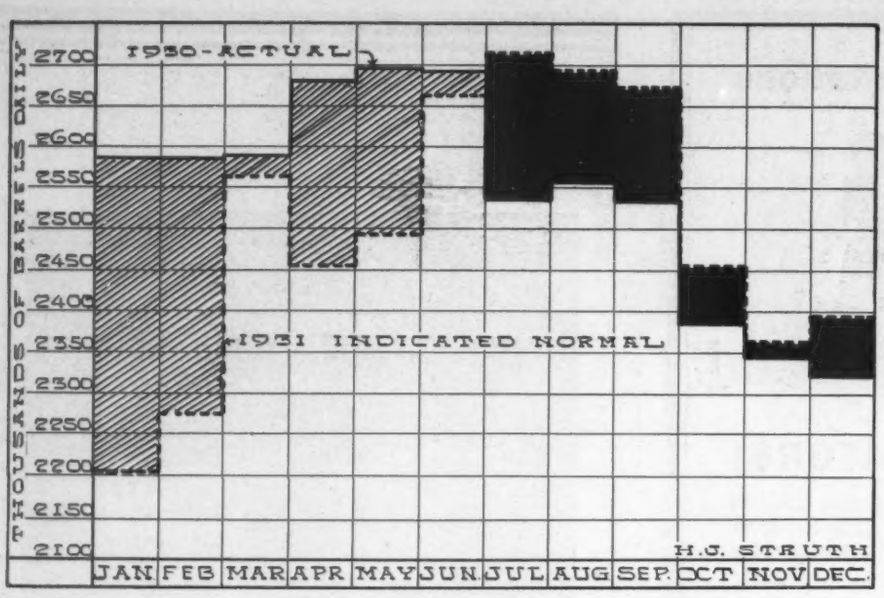

FIGURE 4

Normal course of crude runs (daily average) during 1931, compared with actual course during 1930. Ribbed area shows extent of curtailment necessary during first half in order to attain justified gain during last half of year.

motor vehicle were only about three gallons per car above normal, on an average. What this implied in the way of market returns during 1928 is evidenced by the fact that the price of U. S. motor gasoline averaged 9.15 cents, whereas during 1930 the average had declined to but 6.96 cents per gallon. The difference in market values during those two years is attributed to the difference in mean average gasoline stocks per motor vehicle of about nine gallons, or a burden of roughly six million barrels.

The cost of uneconomic practices in the refining branch of the industry during 1930 is portrayed in Figure 1.

Final statements of the financial results of 1930 are not as yet available, but there is sufficient evidence at hand to prove that net profits were sorely depressed during that period. In fact, on the basis of market values for crude and products, 10 companies alone probably suffered a decline in total net profits of more than $200,000,000, producing a setback comparable in many ways to that of 1927. One distressing factor in the financial situation of the oil industry last year was the necessity for evaluating excessive inventories at depressed market prices. These 10 companies alone no doubt were obliged to write off about $133,000,000 in inventory values, whereas it is conservatively estimated that the entire industry suffered a loss from shrunken inventory values of crude and products of not less than $222,000,000.

What the economic and financial outcome of the oil industry will be this year depends upon the degree of success attained in controlling producing and refining operations. One thing is certain, refiners as well as producers must conduct their operations along sound, economic lines. It is necessary that the industry consider the future effect of refinery expansion outside of the United States, since this trend plainly indicates the eventual dissipation of America's foreign oil markets. There is a distinct opportunity at hand now for the petroleum industry to effect a degree of stabilization that will invite more prosperous times for all concerned. That opportunity lies in a program of production control built upon a foundation of gasoline supply.

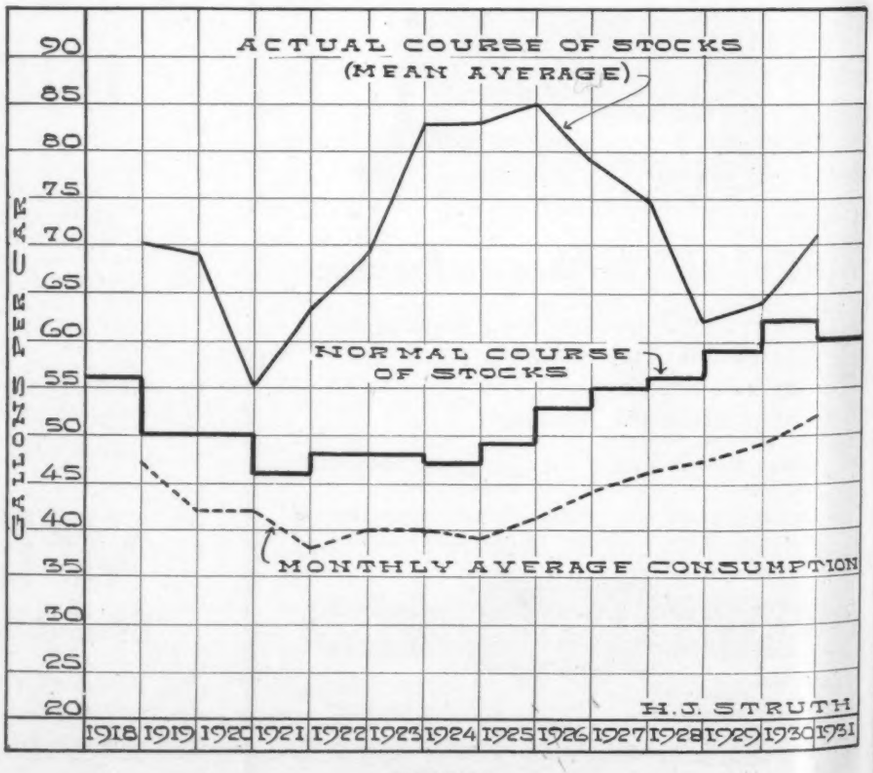

FIGURE 5

Theoretical normal course of gasoline stocks compared with actual course (mean actual average) and trend of consumption, expressed in terms of gallons per motor vehicle.

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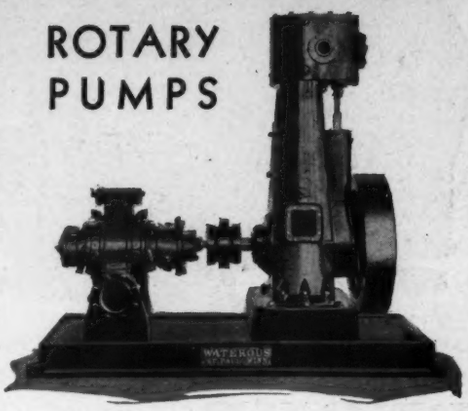

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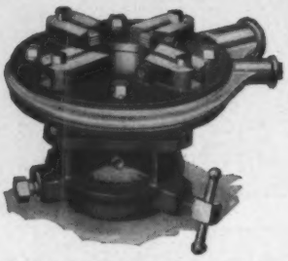

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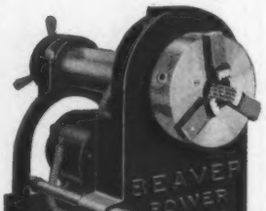

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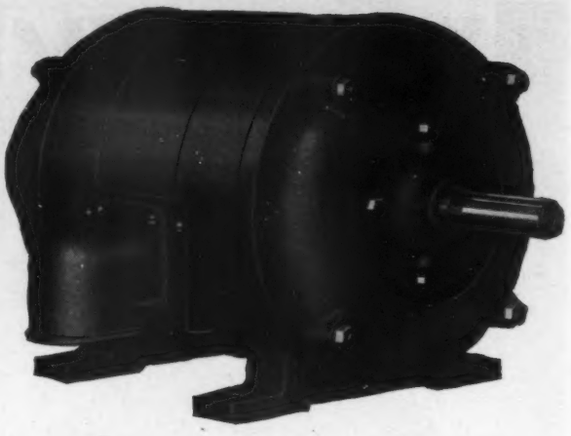

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By GEORGE REID

Corrosion and Heat Resistant Alloys

The American Society for Testing Materials, 1315 Spruce Street Philadelphia, Pennsylvania, has prepared in booklet form "Tables of Chemical Compositions, Physical and Mechanical Properties, and Corrosion-Resistant Properties of Corrosion-Resistant and Heat-Resistant Alloys." The tables and data on composition and properties were assembled by the A. S. T. M. Sub-committee I of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys as a revision of the corresponding tables appearing in the Symposium on Corrosion-Resistant, Heat-Resistant and Electrical-Resistant Alloys held in 1924.

The data are assembled in the form of insert tables. The alloys are grouped according to manufacturer, all of whom co-operated in the work. Improved methods of reporting the mechanical properties at elevated temperatures and the corrosion-resistant properties have been employed. Because of these changes and the generally larger amount of information which manufacturers were able to provide the tabulation will prove to be of greatly enhanced value to the uses of these metals and alloys. The book is available in the form of 11 large tables in a special binder at $1.50 per copy by addressing the Society.

Unit Operations of Chemical Engineering

The recently published book, "Elements of Chemical Engineering" by Walter L. Badger and Warren L. McCabe, both of the University of Michigan, will prove a valuable working tool for the refinery and natural gasoline plant engineer, inasmuch as it provides a simple approach to the unit operations of chemical engineering. The book will be valuable to the practical engineer in this field as well as to the graduate.

Following a timely introduction by Dr. Arthur D. Little, the first chapter on "General Considerations" describes the fundamental concepts and methods used throughout the book. This is followed by "Flow of Fluids" in which the theory is developed and then applied to the operation of measuring devices. "Transportation of Fluids" is descriptive, giving detailed discussions of the uses of various types of pipe, fittings, valves and pumps. The film concept is introduced in a chapter on "Flow of Heat" and is interwoven through the rest of the book. Graphical integration is used in the solution of heat transfer problems.

Based on the film concept an unusual classification of unit operations has been adopted. The chapters on "Flow of Heat and Evaporation" deal with heat flow through fluid films. In the next group of operations there this is again considered and in addition there is also diffusion of material through the films. In this group are humidification and dehumidification, drying, rectification, gas absorption, extraction and crystallization. The work is based on newest research, and is illustrated by pictures and line drawings of latest types of equipment produced by leading manufacturers.

Completing the book there is a series of chapters dealing with more or less unrelated but important topics such as filtration, mixing, crushing, grinding size separation, conveying and weighing, and the like. The book covers all of the important unit operations and describes the theory underlying these operations in a manner adaptable to the needs of the engineer who is called upon to group them for efficient and economical production. Further, the authors present the first systematic classification and description of types of equipment used in the chemical industries unit operations, and distinguish between the fields of usefulness of different types of equipment for carrying out the same processes, thus co-ordinating theory with design. "Elements of Chemical Engineering" may be secured from the Gulf Publishing Company, P. O. Box 1307, Houston, Texas.

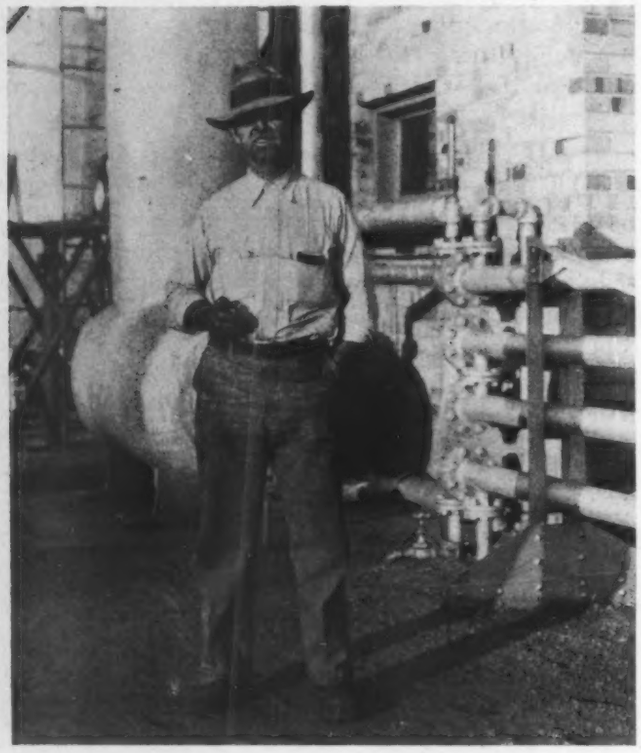
Institute of Technology Completes Field Work

Tests of broad interest in several phase of fuel utilization marked the six months field work of the course in Fuel and Gas Engineering at the Massachusetts Institute of Technology, recently brought to a close. At the Tide Water Oil Company's refinery in Bayonne, New Jersey, gas and oil fired crude stills, solution stills and cracking coils were studied. This company co-operates each year in the training of young men for industrial work. Other companies offering their co-operation are Bethlehem Steel Company, Rochester Gas and Electric Corpora-

tion and Edison Electric Illuminating Company. The field work follows a year's study in theory of combustion, natural and manufactured fuels, power development, heat flow and kindred subjects in the graduate course at the school mentioned.

Safe and Clean Plants

H. U. Jarrett, district superintendent, Stanolind Oil & Gas Company, Tonkawa, Oklahoma, has more economy kinks in his plants than most. He doesn't waste his live steam to keep his pump house and engine building warm. He takes the uncondensed steam from the preheater; traps both water and steam through a Vigilent; dumps the water into the boiler hot well and delivers the rest to the radiators. Then that comes back through return lines to the hot well when it condenses.



H. U. JARRET
Plant is neat and safe.

He has made connections to the mineral seal storage so that he can empty the entire absorbing and distillation system in seven minutes. In case of fire or a line break, he is pretty safe. Probably had to contend with old type, long, two-inch lines inside of eight-inch lines called heat exchangers in those days, in "Hog Town," in Texas, where he worked for a while.

All the waste oil from the centrifugal oil pumps is collected in an automatic dump trap which empties into the lean oil tank. Result—no waste, no mess, under the manifolds.

Carnegie Medal For Irl H. Lantz

A bronze medal, commemorating an act of heroism which almost cost him his own life in saving that of another was awarded to Irl H. Lantz, superintendent of the Dallas Texas, refinery of Simms Oil Company, by the Carnegie Hero Fund Commission early in February.

IRL H. LANTZ
Deserves Medal—Gets It.

On September 1, 1929, Lantz, then superintendent of the Simms refinery at Smackover, Arkansas, was aiding in extinguishing a fire which had started on an oil covered creek near the refinery. In an adjoining slough Dudley W. Caswell, Jr., a painter, was wading up to his knees in rotting earth and mud toward a smoldering stump when gas arising from the oil saturated mire suddenly ignited, surrounding the painter-fire fighter in an inferno of flame. Mr. Lantz cut his way to the man and carried him to the bank and to safety. Caswell was but slightly burned but Superintendent Lantz spent the next three months in the hospital recovering from severe body burns.

At no time during our acquaintance of some three years has Irl ever said a word about his experience, and due to his modesty we had to swipe the story from the Dallas News and borrow the above picture from the same source.

More About Alcotate

Alcotate, a denaturant from petroleum developed by the research laboratories of Standard Oil Company of California, which is harmless save that it induces nausea, and which has the odor and taste likened to putrid eggs and garlic, was discussed in this department in the issue of January, 1931, page 131. Since that time the United States Bureau of Industrial Alcohol has announced specification for this material as follows:

1. A petroleum product free from water and all suspended materials, having a specific gravity of not less than 0.850 at 60° F. (Approximately 35° A. P. I.).

2. Sulphur—(a) The sulphur content shall be not less than 4.5 per cent, as determined by the bomb method. (b) It shall contain no hydrogen sulphide,

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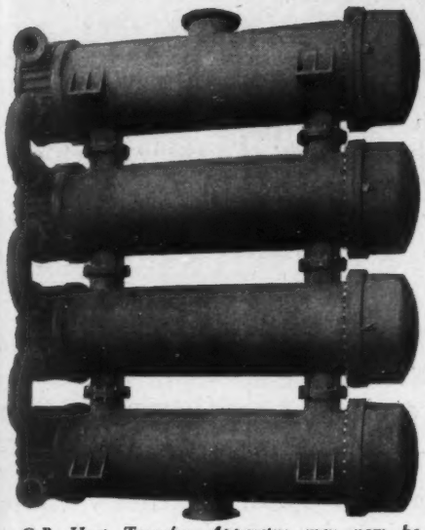

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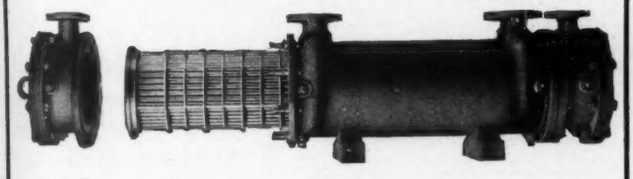

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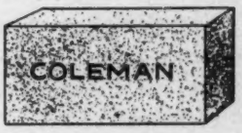

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carbon bisulphide, or added elementary sulphur. (c) The percentage of sulphur in the fraction distilling between the 20 per cent and the 70 per cent A. S. T. M. fractional distillation points shall not be less than 80 per cent of the percentage of sulphur in the original sample.

3. Distillation range (A. S. T. M. method- D-86). (a) When 20 per cent has been recovered in the receiver, the thermometer shall not read higher than 347° F. (175° C). (b) When 50 per cent has been recovered in the receiver, the thermometer shall not read higher than 383° F. (195° C). (c) When 90 per cent has been recovered in the receiver, the thermometer shall not read higher than 473° F. (245° C).

4. Solubility in 95 per cent ethyl alcohol—when mixed at 25° C with an equal volume of 95 per cent ethyl alcohol there shall be no separation.

5. Turbidity test.—When 25 cc. of a 1½ per cent solution of alcotate in 95 per cent ethyl alcohol is titrated with distilled water, the solutions being held at a temperature of 77° F. at least 8 cc of water shall be required to produce a turbidity equal to that of the standard, freshly prepared by dissolving 1½ grams of chemically pure lead acetate in 100 cc. of water at 77° F.

"Wadeolene" Returns As Hydrogenation

A new company styled Standard Hydrogenation Corporation, Chrysler Building, New York City, announced February 15 that a new process for converting heavy oil residue into gas suitable for heat, light, and power purposes has been developed. Five plants are to be erected at once in as many North Carolina towns and company statements assert that franchises have been given it for supplying 178 communities with such service. A motor fuel called "Wadeolene" is produced in the operation of these plants with recoveries reported at 50 to 80 per cent.

Henry Clay Wade is chairman of the board and H. S. Rubens is president of Standard Hydrogenation Corporation. George E. Owens is chief engineer. The process by which this gas and motor fuel is to be manufactured has been known for several years as the Wade process for cracking petroleum. In 1923 Inventor Wade had a small plant at Butler Road and Getty Drive, Santa Fe Springs, California. In 1925-26 a larger plant was periodically operated on Cherry Avenue, Signal Hill, Long Beach field, California. This plant was briefly described in The Refiner and Natural Gasoline Manufacturer, Vol. 5, No. 11, November, 1926, page 24. (Other references, Petroleum Times, 1926, Vol. 16; page 94; Chem. Abst., 1927, 21,2378; Hydrogenation of Organic Substances, Ellis, Third Edition, page 591, No. 4917). The company now has a small plant at Bayonne, New Jersey, where fabrication and process details, although apparently improved, are somewhat similar to the earlier Wade plants.

W. C. Teagle, president of Standard Oil Company of New Jersey has issued a statement to the effect that Standard Hydrogenation Corporation has no connection with Standard Oil Company of New Jersey, or the Hydro Patents Company which owns patents for the hydrogenation process of German development and later further developed and applied in this country.

Waste Disposal Committee Chairman

John S. Hess, Sinclair Refining Company, New York, has been appointed chairman of the Committee on Disposal of Refinery Wastes of the American Petroleum Institute's Division of Refining. He succeeds A. S. Russel, Standard Oil Company of California, who has resigned both chairmanship and membership.

L. G. Metcalf, Union Oil Company of California, Los Angeles, has been appointed a member of the committee.

The committee, having published Section I, "Water Waste Containing Oil," of the A. P. I. Manual on Disposal of Refinery Wastes, is now preparing Section II, "Waste Gases and Vapors."

Wyoming Plant Men Promoted

A. E. Thompson and R. E. Beard, both with Standard Oil Company (Indiana) at Casper, Wyoming, have been promoted to positions of assistant general superintendent of the combined Casper plants. Mr. Thompson has been with the company since 1903 and was transferred to Casper in 1913, where he became assistant superintendent of plants 1 and 2 in 1918. Mr. Beard went to the Casper refinery in 1922, becoming foreman of the steam refined treating and acid departments in 1923.

Michigan University Chemical Engineering

The Department of Chemical Engineering, University of Michigan, Ann Arbor, Michigan, has issued its 1931 bulletin dealing with chemical engineering, including its graduate programs in general chemical engineering, metallurgical and gas engineering and organic chemical industries. The bulletin discusses the engineering profession and the chemical engineer in addition to the university's fa-

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By years of experience in assembling by welding all grades of chrome and chrome nickel steel for special installations in refineries, chemical plants, mills, food industries and dye equipment, etc., we have developed sound, homogeneous, ductile, alloy welds of great strength.

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No time lost for repairs—absolutely dependable in performance. That is the record of Sterling Oil Sections. One outstanding example of performance is a single coil in a prominent modern refinery,* which condenses and cools 3000 barrels of gasoline daily, in addition to steam and fixed gases, cooling the stream to within 5 degrees of the water temperature. They have not had a leak or a shut-down for repairs since they installed Sterling Sections, more than two years ago. This is one experience—we can tell you of many others.

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cilities for instruction and research. The demand for men with a doctor's degree is much higher than the supply, and the salaries paid to men with a doctorate are reported about twice as high as those received by men having only a four-year course. The demand from the petroluem industry is adding a large number of chemical engineers each year.

Gasoline Association Convention Dates

The annual convention of the Natural Gasoline Association of America will be held again this year at the Mayo Hotel, Tulsa, on May 19 to 21. The program committee will have the program ready for announcement in the near future. The Natural Gasoline Supply Men's Association again plans to furnish the entertainment and to serve Dutch lunches each noon during the three days of the convention.

New Houston Refinery Personnel

The American Petroleum Company, which recently completed a new 2500-barrel refinery at Norsworthy, on the Houston Ship Channel, has secured R. C. Cooke as superintendent of the plant. W. W. Moore is president of the company and Craig S. Cullinan, son of J. S. Cullinan, is in charge as manager. American Petroleum Company also operates a 70-mile pipe line from the Hull field, in Liberty County, to Norsworthy.

Superintendent Promoted

W. R. Boroughs of The Texas Company, who was at one time with the company's refinery at Casper, Wyoming, and for the past two years has been in charge of operations of the International Refining Company plant operated by The Texas Company at Sunburst, Montana, has been promoted to superintendent of the company's refinery at Amarillo, Texas.

Physical Chemist Goes to Whiting

D. S. Villars, on leaving the University of Minnesota where he was assistant professor in physical chemistry, spent five months at the Research Laboratory of General Electric Company at Schenectady, New York, and has now accepted a position as physical chemist with Standard Oil Company (Indiana), Whiting, Indiana, plant.

Technical Staff Enlarged—

Texas Pacific Coal & Oil Company, Fort Worth, has enlarged its technical staff in its research and routine laboratories through the addition of D. C. Bolin, chemical engineer. Mr. Bolin, for the past few years has been manufacturing superintendent and technical adviser for sugar interests in South America.

Seminole to Wichita, Kansas

V. F. Hobart, gasoline plant superintendent, has moved around a bit. He came from Washington State to enter employ of Empire Oil & Refining Company. They sent him to Seminole—mud, rain, sleet, no roads, plenty of oil and gas. He says he has moved around so many times he has forgotten the plants. Now he is at Wichita, Kansas, where he reports having lots of fun with a word that means

V. F. HOBART
Different from Seminole

the river which is not far from his plant, ArkanSAW, further east and south, but where he is it must be ArkanSAS. He enjoys having about the best system of cooling water that you will find in several days driving. He is not concerned with the evaporation, either to cool the water, or fear that by evaporation he will not have enough water for the next day. He has all of the under ground river where he is to draw from at an average of 65° F. in the summer and winter to put over his coolers and then—he throws it away. Nice operating conditions, too. His gathering system is of no bother. His raw material is delivered to him under 450 pounds pressure. He keeps absorbing oil in the system and extracts 25,000 gallons of gasoline each day.

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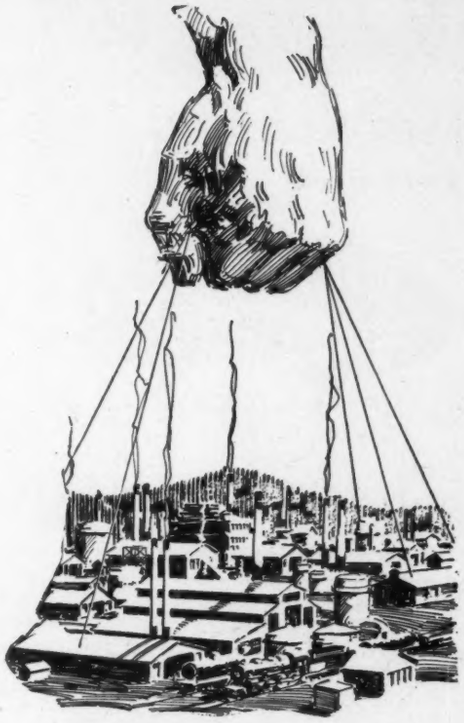
. . . raises the Petroleum Industry to higher levels



CHEMISTRY and Chemical Engineering are keeping the petroleum refiner steadily advancing to higher economic levels. Chemistry is, in fact, the key to survival in the refining field.

Every man responsible for methods, materials, machinery, processing efficiency, product quality and sales promotion in any branch of the petroleum industry, owes it to himself, his profession, his employers and his Country to maintain that leadership necessary to prosperity via Chemistry and the allied sciences.

Ready to the hand of those for whom chemical science can do so much is this year's Exposition of Chemical Industries.

Viewed as a whole it will be a striking demonstration of Industry transformed by Science.

Viewed in detail, it is a post-graduate course without which previous education is hopelessly handicapped in dealing with the needs of the day.

Available at this great national institution of learning will be opportunities to discuss your interests with hundreds of specialists in attendance to serve you.

EXHIBITS—visual, tangible, comparable embodiments of progress—include processing equipment, instruments of precision, chemicals, chemical products, laboratory supplies and a wide variety of technical products used in oil refining.

Attending this Exposition yourself is not enough. Bring from your organization those who have operating responsibilities requiring knowledge of modern methods, machines, materials. And bring those whose "sayso" counts when newer, better equipment is needed. They'll be glad they came. So will you.

13th Exposition CHEMICAL INDUSTRIES

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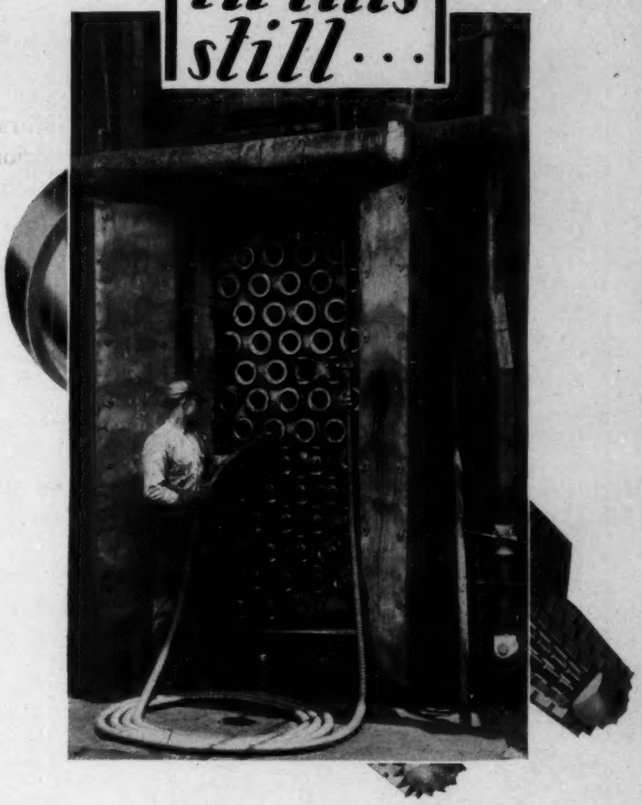

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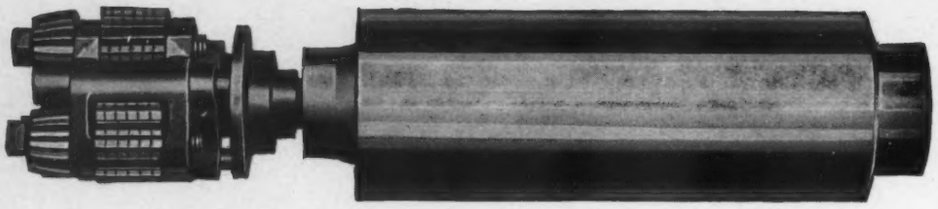
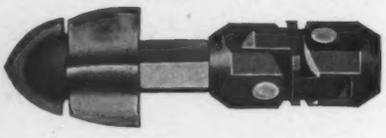


Roto air-driven Cleaner for Oil Still Tubes, made in sizes for 3″ tubes and larger.



Roto Still Type Drill Head

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The Weather— Mostly cloudy and somewhat warmer tonight; Saturday fair.

THREE CENT

ACID TANK BLAST KILLS MAN

REFINERY WORKER AT KARNS CITY IS EXPLOSION VICTIM

Leonard S. Yough, Aged 56, Was Drawing Contents of Tank Into Vats.

OFFICIALS ARE UNABLE TO EXPLAIN ACCIDENT

Pieces of Steel Are Thrown 100 Feet When Tank Is Blown from Underframe.

One man was killed, an entire district rocked, a tank car demolished and the Baltimore and Ohio Station completely drenched with acid when a tank car of sulphuric acid exploded at 8 o'clock this morning on the Pennsylvania Refining company's siding at Karns City. Leonard S. Yough, aged 56, who was unloading the car, was [illegible] feet by the blast and instantly killed. Death was due to a fractured skull.

Are you taking this chance in *your* plant? (*You don't need to*)

The evening paper carried a startling headline: "Acid Tank Blast Kills Man." A tank car of sulphuric acid, while being unloaded by air pressure, blew up with disastrous results. The chance of such an accident at your refinery is eliminated by Duriron unloading equipment—acid-resistant, self-priming pump, valves and pipe. Resisting corrosion and abrasion, Duriron equipment gives greatest safety with economy. Full details will be gladly sent on request.

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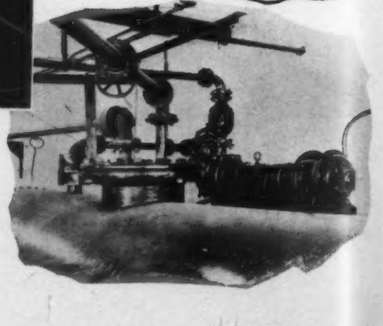

REFINERY AND GASOLINE PLANT ACTIVITIES

New Plants – Construction Notes – Personnel Changes

POSSIBILITIES of an ample supply of high gravity sweet crude on long time contracts at distress prices are attracting independent refiners to the new flush fields of East Texas in Rusk and Gregg Counties. Reports for the month indicate that Texas will increase its refining capacity by approximately 52,000 barrels daily in the near future with about 40,000 barrels of this total being installed now or soon to be erected in the East Texas producing districts.

Six refineries are in various stages of completion in the counties affected by the development of the East Texas fields and three more plants are proposed. All of these activities are confined to independent refineries who are building plants ranging from 2000 to 10,000 barrels daily capacity. In the meantime crude from these fields is being shipped by tank car and pipe line to refineries in Arkansas, Louisiana, Texas, Missouri, and Eastern Canada. New refineries in the Texas Panhandle, Gulf Coast, and Southeastern Texas completed the total capacity as reported above.

Additional expansion and enlargement activities in the refining industry continues to be manifested this month with five foreign plants proposed and one foreign cracking unit. Seven expansion programs of varying importance are underway. One new plant in Ohio has been completed and placed in operation. The details of this activity are presented in the following news notes.

Gasoline Plant At Oklahoma City

Anderson-Pritchard Oil Corporation is to construct an absorption type natural gasoline plant at the north end of the Oklahoma City field. The company is also enlarging capacity of its refinery at Cyril, Oklahoma, and has recently completed new construction at its plant at Colorado, Texas, (jointly owned with Standard Oil Company of California, and known as Coltex Refining Company).

Apache Building Panhandle Refinery

Apache Refining Company has completed plans for the erection of a 5000-barrel daily capacity skimming plant at Sunray, in Moore County, Texas Panhandle. The town of Sunray was formerly known as Altman, Texas. The present name is taken from that of the Sunray Oil Company, Tulsa, Oklahoma, which will supply crude oil to the new refinery. W. J. Batchelor, formerly of Los Angeles, is president of Apache Refining Company. D. C. Langford is superintendent of the new refinery. The Moore County crude to be processed is 36 gravity. The company has under advisement the construction of a natural gasoline plant to serve the new field.

Beacon Building In Rusk County

Beacon Oil & Refining Company is erecting a skimming plant two miles north of Henderson, Rusk County, Texas, on the I. & G. N. Railway. Plant capacity is 2000 barrels per day. The company is also building a four-inch pipe line from the Joiner field to a 40-car crude oil loading rack at the refinery site. J. E. Parker is president of the company and H. W. Roberts is secretary-treasurer and general manager. Mr. Roberts is owner of Falls Refining Company which has a 2500-barrel skimming plant at Wichita Falls, Texas.

Absorption Plants For Burma

C. F. Braun & Company was recently awarded a contract to construct two absorption plants in Burma, the first to be built in this part of Asia. E. L. Varney, construction engineer for the company, sailed from San Francisco to supervise the erection of the two plants. Plants have been built in Persia, but the two now under construction represents a considerable extension of activities.

Enlarge Refinery At Conrad, Montana

The Conrad Refining Company, Conrad, Montana, has announced that it has recently contracted to furnish the Great Northern railway with one car of fuel oil per day. The company is making improvements on its plant and storage capacity is to be increased by 20,000 barrels. A new 1000-barrel still is to be built with new modern bubble tower, which will increase the output and raise the quality of the refined product. The company plans to manufacture road oil.

Continental Building New Unit at Ponca City

Continental Oil Company, at its Ponca City, Oklahoma, refinery has awarded contract for the construction of a new 3500-barrel tube still type lubricating oil unit to Alco Products, Inc., the recently formed division of American Locomotive Company. Construction is to be completed July 1.

Two East Texas Refineries

East Texas Refining Company will build two refineries in the new East Texas fields instead of one, as was originally announced, (see Refiner, February, 1931, page 144), according to F. W. Burford, president of the company. The company is now building a 6000-barrel skim-

REFINERY AND GASOLINE PLANT ACTIVITIES

ming plant at Henderson, Texas, and a plant of similar capacity is under construction at Longview, Texas. Headquarters of the company are at Dallas, Texas. J. J. Thomas, vice-president of Burford Oil Company, headed by F. W. Burford, is also vice-president of East Texas Refining Company and in charge of construction and operation of the two plants. H. H. Knoch, formerly superintendent of refinery operation for Crystal Oil Refining Company, Shreveport, Louisiana, has gone to Pecos, Texas, to take charge of operations there for Burford Oil Company, relieving Mr. Thomas from his duties there insofar as plant operations are concerned.

Modernize California Plant Exeter Oil Company, which recently purchased the old Perfection Refining Company plant at Hynes, California, has announced plans for the reconditioning and modernization of the 1000-barrel refinery. W. R. Cowan, formerly vice-president of United States Refining Company (operating a 5000-barrel plant at Hynes and a 1500-barrel plant at Torrance), is president of Exeter Oil Company.

Point Isabel Refinery Planned Leo Petroleum Company, Fort Worth and Reid Bishop are reported planning the construction of a 1000-barrel skimming plant at Point Isabel, below Brownsville, Texas, to operate on Refugio crude.

Southwest Texas Plant Planned Luling Oil & Gas Company, Milan Building, San Antonio, Texas, is reported contemplating the erection of a 3000-barrel skimming plant at Refugio, Texas, to operate on Refugio crude. T. N. Smith is president of the Company.

Montana Plant Increases Capacity Northwest Stellerene Company, Inc., Shelby, Montana, has increased its refining capacity from the original 1000 barrels to 1500 barrels daily. The company uses the Leamon vapor-phase cracking system for increasing production of motor fuel.

Pacific Western Compression Plant Pacific Western Oil Company is installing a compressor unit to be used in connection with its Elwood Terrace absorption plant. Three 160-horsepower Western Gas engines and Ingersoll-Rand compressors will be used. The unit will be employed primarily to flow the oil wells in the field, this practice to maintain a well pressure which will allow the absorption plant to operate directly from the gas traps. Fluor Construction Company is installing the compressor unit.

Pure Operating Toledo Plant Pure Oil Company placed its new 8000-barrel combination skimming-cracking plant at Toledo, Ohio, in operation late in February. Crude is supplied from the Michigan fields by barge and from the Mid-Continent through the Ajax pipe line of which Pure Oil Company is part owner. The plant consists of three combination Gyro units utilized to top and crack the crude with a recovery of 60 per cent gasoline. R. D. McClaren is general superintendent in charge of both the Toledo and the Newark (Heath), Ohio refineries. O. B. Weldeln has been made superintendent of the Toledo plant and E. E. McPherson is superintendent of the Heath refinery.

Canadian Plant Proposed Radio Oil Refiners Ltd., Tulsa, is reported contemplating the erection of a refinery at Winnepeg, Canada, of 1000 barrels capacity. Estimated cost $150,000. It is proposed to move crude from the United States for refining in Canada in the plant, and for distribution of products in Western Canada.

Richfield Vapor Recovery Unit Richfield Oil Company of California is making substantial additions to its vapor recovery plant recently completed near its Hynes refinery. A stabilizing unit of 50,000-gallon capacity is being added. Fluor Construction Company is building the new unit.

Long Beach Plant Enlarged, Improved Signal Oil & Gas Company has purchased the 5000-barrel refinery formerly operated by U. S. Refining Company at Long Beach, California, and will make additions and improvements which will add to the efficiency of the plant. Included in the deal were several hundred retail outlets. The purchasing company operates eight natural gasoline plants producing about 160,000 gallons of gasoline daily. Some of these plants are operating in Oklahoma and Texas. The merger brings the Signal Oil & Gas Company into the lists of integrated organizations operating in all three branches of the industry.

Enlarge Italian Cracking Capacity Societa Distillazione Italiana Combustibili, Venice, Italy, announces that its cracking facilities will be enlarged by the addition of a Dubbs cracking unit. Reports state that the company is expected to increase its capital apparently for the purpose of purchasing new cracking equipment.

France Plans Four Plants Societe des Raffineries de Petrole de la Gironde, Paris, France, has secured a concession for 148 acres for a site on which to build a skimming and cracking (Dubbs) plant of 2,100,000 barrels annual capacity at Bec d' ambes, according to an unofficial announcement of the United States Department of Foreign and Domestic Commerce, which gives credit to a reliable source. The same announcement states that Compagnie Industrielle des Petroles of Paris, has purchased a 50-acre tract for a proposed refinery at Frontignan. S. A. Brest Port Petrolier, Paris, has taken a concession on 95 acres at Brest, where it contemplates the construction of skimming and cracking facilities. S. A. Unipetrole (S. A. d'Etudes pour favoriser le Development de l'Industries du Raffinage en France—— "research organization for the advancement of the refining industry in France") also has a concession for 17 acres for a site at La Pallice where it is proposed to construct a skimming and cracking plant of 1,500,000 barrels annual capacity.

Rectifier Completed Standard Gasoline Company, subsidiary of Standard Oil Company of California, recently completed the erection of rectifying unit at its Ventura Avenue absorption plant. The unit is largely of the company's own design and has a capacity of 100,000 gallons of gasoline per day.

Ohio Standard Enlarges Plants Standard Oil Company of Ohio has increase capacity of its plant at Cleveland to 20,000 barrels daily. Cracking facilities at the Latonia Refining Company's plant at Covington, Kentucky, (a subsidiary company), has been increased from 2500 to 4000 barrels. Newspaper reports

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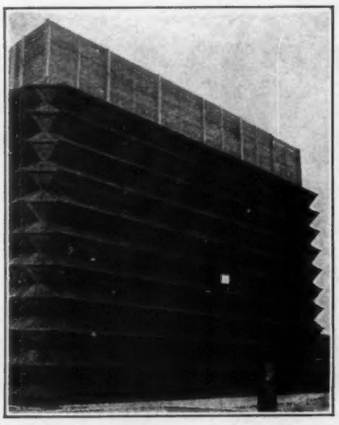

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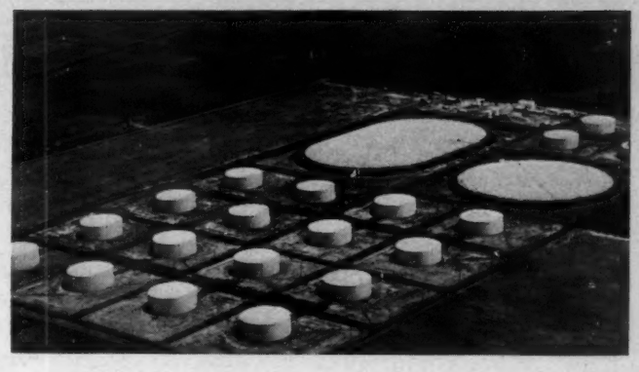

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REFINERY AND GASOLINE PLANT ACTIVITIES

from New York state that Standard Oil Company of Ohio plans to build an asphalt plant at Toledo involving the expenditure of $750,000.

New Jersey Cracking Units Standard Oil Company of New Jersey, is erecting four Tube and Tank type of cracking units at its Linden, New Jersey, refinery and two units of the same type at its Baltimore, Maryland, plant. These units partially replace older equipment. The Linden plant capacity will be increased about 3000 barrels.

Cracking Unit at Bakersfield, California Standard Process Company has been awarded the contract for a 500-barrel cracking unit to be installed for L. C. Osborn of Bakersfield, California. The new plant will be operated on crude from the Fruitvale field. H. D. Rycroft is in charge of the Standard Process Company, with offices at Bakersfield.

Taylor Plant Building In East Texas Taylor Refining Company is receiving material for the construction of an 8000 barrel skimming plant at Tyler, Texas. The company plans construction of a 24-mile pipe line, (six-inch) to the Joiner pool. G. L. Rowsey is president of Taylor Refining Company, which also operates a 6000 barrel plant at Taylor, Texas. (See Refiner issue of February, 1931, page 148).

Stabilization Unit at Wilmington Plant Union Oil Company of California is building a stabilization plant for treating natural gasoline recovered through its vapor recovery plant at the Wilmington refinery. Technical Engineering Corporation is assisting the company in the erection of the plant.

Proposed East Texas Plants F. C. Winters of Kansas City is reported to be negotiating for a site and crude oil contracts and planning the erection of a 5000 barrel skimming plant near Kilgore, in the new East Texas oil field. Dan Brooks of El Dorado, Arkansas, and associates are reported to have obtained option on a tract of land near Longview, Texas, on which a new refinery is proposed. J. P. Gillen, formerly identified with a refinery at Houston, is heading a group that has started preliminary work on a 2500 barrel skimming plant near Overton, Texas. L. G. Welsh, Fort Worth, and associates, are surveying route for a six-inch pipe line that will originate on the Deep Rock-Foster et al's Ashby lease, in the Joiner field, and extend to the refinery at Overton. Butler & Calhoun of Corsicana, Texas, and associates are reported to be planning erection of a refinery at Overton, Texas, which is to be connected with the Joiner pool by a four-inch pipe line. Sabine Oil & Pipe Line Company has been organized by L. H. Gray of El Dorado, Arkansas, to build a pipe line from the Joiner field to Friars Switch, near Henderson, where it maintains headquarters and plans erection of a 2000 barrel skimming plant.

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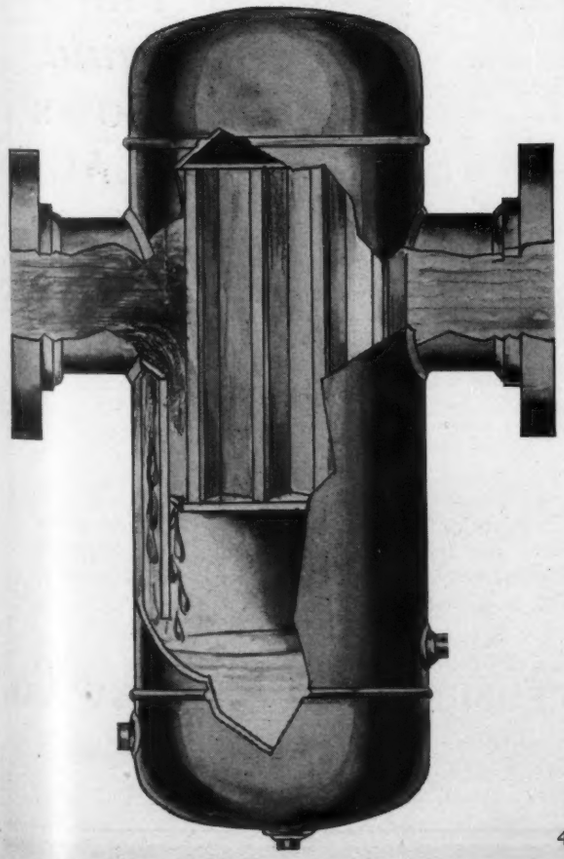

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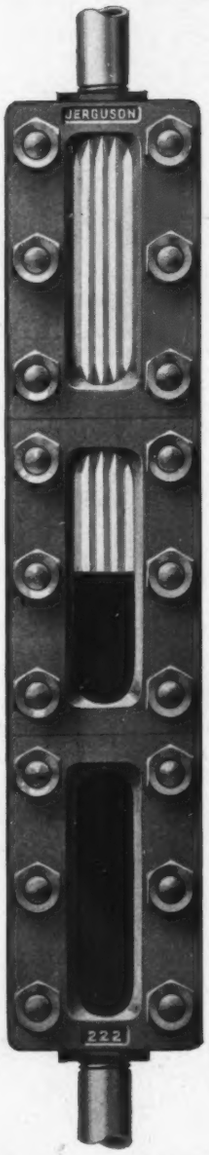
JERGUSON

REFLEX GAGES

have been used for steam boilers for 25 years and are now being used by leading oil companies for indicating oil levels in tanks, towers, stills, etc.

The *empty* space appears WHITE



The *liquid* shows BLACK

They are safe and durable at the highest pressures and temperatures. We can furnish gages with or without valves for every type of service. Full information upon request.

Jerguson Gage & Valve Co.
87 FELLSWAY
SOMERVILLE, MASS.

New Equipment for the Modern Plant

Diesel Marine Engine

COOPER-BESSEMER CORPORATION

Cooper-Bessemer Corporation, Mt. Vernon, Ohio, exhibited for the first time at the New York Motor Boat Show in January the new 600 horsepower Diesel marine engine, Model JT-8, which has eliminated spray nozzles from the cylinder heads. The absence of these spray nozzles makes more accessible the heads in the event of an occasion for removing them.

The new model develops its rated horsepower at 450 revolutions per minute. It has a bore of 11½ inches and a stroke of 15 inches. Like other Cooper-Bessemer engines, it has a large crankshaft being eight inches in diameter both on the pins and on the bearings.

Although the motor exhibited at the show is an eight-cylinder type, the same principals are incorporated in three-, four- and six-cylinder models built after the basic designs of the JT-8. The two smaller sizes are constructed for generator work and the larger models are direct reversible types for marine service.

For speeds up to 360 revolutions per minute, the lubricating oil, circulating water and bilge pumps are of the built-in plunger type. For speeds over 360 revolutions per minute, motor driven pumps of dual capacity are furnished with the engine. No compressor is built-in in either case but a motor driven 250-pound pressure compressor is used.

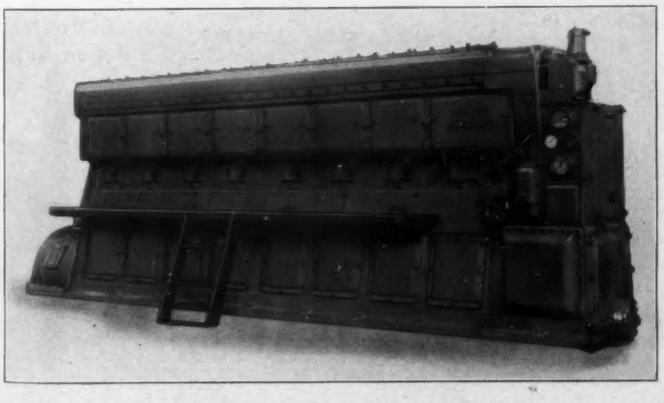
The base of the JT-8 is semi-steel, extra heavy boxing under each bearing. The entire crankshaft is drilled for forced-feed lubrication. The main bearings and crank bearings are of cast steel, tinned and babbitted by centrifugal casting. The connecting rods are to the same specifications as the crankshaft with removable connecting rod boxes while the foot of the rods and the top of the box are scraped to fit.

The pistons are grey iron except for high speed work when either alloy pistons are used or special type grey iron pistons.

The cylinder heads are fitted with single intake, exhaust and air starting valves in easily removable cages. The exhaust valve cage is water cooled. Circulation between the head and the center frame is in four places 90 degrees apart giving perfect water circulation and heat distribution. The head is counter seated on the cylinder with an asbestos copper gasket.

The valves are one-piece alloy forged steel of high heat resisting qualities. Inlet valves are, likewise, of special material suited to the purpose. An overspeed governor controls the fuel injection while the timing is entirely automatic.

The JT-8 has an overhead, chain-driven camshaft used in all Cooper-Bessemer engines. Control of the motor is unified in two levers, one for acceleration and one for maneuvering, starting, stopping and reversing.



Cooper-Bessemer Diesel Marine Engine

New Designs in Plant Equipment Will Be Shown at the California Oil Show

Both equipment and operating methods of interest to refiners and natural gasoline manufacturers will be featured at the Second Annual Oil Equipment and Engineering Exposition which will be held in Los Angeles from March 16 to 22, 1931. A new building with 72,000 square feet of exhibiting space has been erected for the display of all types of apparatus while an extensive outside space will be used for showing cooling towers and the larger plant equipment. Technical meetings will be held for the discussion of methods of operation and engineering exhibits will give all visitors an opportunity to study the trend in equipment design.

Since this is the only oil show to be held during the entire year of 1931, the manufacturers are making every effort to present all the latest types of equipment for the benefit of the operators. Several pieces will be brought out for the first time during the exposition and many improvements will be demonstrated. Besides the larger plant equipment, there will be complete lines of meters, regulators, control instruments and many other devices developed for greater operating efficiency.

The California Natural Gasoline Association will hold a meeting preceded by a dinner on the night of March 19 at which time several important subjects will be discussed. The association will also have a booth at the exposition and will here have available many valuable data and information for dissemination to all interested in this branch of the industry. The Southern California Meter Association will hold its meeting in the Technical Hall at the exposition after a dinner on March 20. This meeting will be made of considerable interest to all oil men and will include papers on measurement, control and regulation of gas.

The Oil Equipment and Engineering Exposition is realizing its aim to make the show of outstanding interest for the petroleum industry from both the side of equipment display and that of operating information and instruction. In order to permit visitors to enter at their convenience every day and as often each day as they desire, no admission charge will be made to anyone connected with the oil industry.

Mineral Wool Insulation

EAGLE-PICHER LEAD COMPANY

Eagle-Picher Lead Company, 134 North LaSalle Street, Chicago, recently entererd the oil refining industry with mineral wool insulation fabricated

in the following forms: Eagle blanket insulation, Eagle pipe insulation, Eagle insulating cement and Eagle granulated wool. A factory for turning out these products has been established at Joplin, Missouri following successful tests on mineral wool insulation made in a small test plant.

The first step in the manufacture of this product is to melt the charge (consisting largely of flint rock, lime, iron oxide, and alumina) in a furnace similar to an iron foundry cupola. At white heat, the material flows continusously from the bottom in a small stream. Before it has an opportunity to solidify, live steam, blown at high pressure, is shot into it. The mass scatters with comet-like speed; and as it is hurled into a large receiving chamber, it becomes fluffy and fibrous. The fibrous mass, which is now Eagle insulating wool, settles on a moving floor. It may be conveyed either to the packing room for shipping, or through additional operations which result in the fabricated forms. By controlling the composition of the charge, the temperature, and the steam pressure, various grades of Eagle insulating wool are produced. These are manufactured to conform to the specifications of the individual buyer.

The Bureau of Standards reports .286 at 202.40°F. as the conductivity rating for Eagle insulating wool. This figure represents the number of heat units which would flow through a section of Eagle insulating wool one foot square by one inch thick in an hour for each 1°F. difference between the temperatures of the inner and outer surfaces. Eagle insulating blankets and Eagle pipe insulation were especially designed for the oil refining industry.

The blankets are made of the loose wool, felted between two metal laths or between metal lath and mesh. Standard sizes are eight by two by two inches thick and four by two by two inches thick. However, any size or thickness may be secured, depending on the individual requirements of the user. These blankets are used on boilers, towers and stills; adjusted around the surface and banded in that position. They are then coated with insulating cement and water-proofed. Eagle insulation is full of minute air cells or voids, giving the material a light weight.

Two types of Eagle pipe insulation are now being marketed. Each is essentially a blanket, but rolled into cylindrical shape and designed especially for pipes used in oil refining. In Eagle "77", the inside metal fabric is a copper bearing metal lath cut and spaced exactly to fit the outside circumference of the pipe. The outside fabric is copper bearing expanded metal lath. Cement is usually applied over this outside lath, although it is not always necessary. Eagle "88" has the same type of blanket and covering used on "77", but in addition a galvanized ingot iron sheet cover is furnished.

Further information on these new insulating materials of Eagle-Picher Lead Company may be secured by writing the address given above.

Stabilizer

THE FOXBORO COMPANY

The Foxboro Company, Foxboro, Massachusetts, announces the new Foxboro stabilizer, the latest development in the field of automatic control, and which is having its premiere showing at the Oil Equipment and Engineering Exposition in Los Angeles.

The design offers complete command of the controlling medium. It is developed principally to meet control problems such as tops of towers, pipe stills, re-

JUNIOR CONTROL

Master and Junior Controls also equipped with mercury switches for remote signal lights.

REMOTE CONTROLS

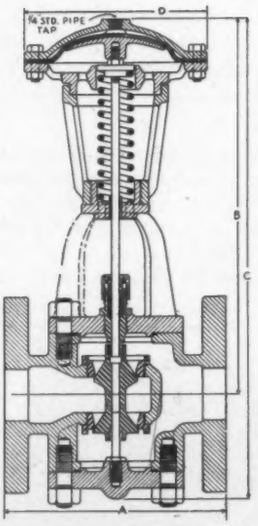
Announcing - Improvements - New Developments

S&J REG. U.S. PAT. OFF.

With the application of a thrust bearing and the development of a frictionless float shaft, all possibility of sluggishness under the most severe operating conditions is entirely avoided.

Refinery engineers using this improved control express their entire satisfaction and of the remarkable throttling action obtainable.

A new Bulletin will soon be off the press, and will be sent upon request.



BALANCED TYPE VALVE

The heart of a Control is the Float. S & J Floats are made in our plant of KA2 Steel and manufactured by a special process insuring long life.

S & J Diaphragm Valves have been redesigned with extreme care and thought given to the ease of maintenance and service. All parts are easily accessible, the packing gland has ample space for repacking, the diaphragm head is extended a greater distance from the body, prolonging the life of the diaphragm. An upper guide to assure definite stem alignment. All important parts are of KA2 stainless steel. The valve can be converted from direct to reverse-acting. Friction has been reduced to a minimum. A Better Throttling Action is not possible.

SECTION THROUGH CONTROL

SHAND AND JURS CO.

BERKELEY · CALIFORNIA

Representatives

NEW YORK DENVER TULSA
LOS ANGELES SEATTLE
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Facts About Firebrick Joints

Fourteen years ago we strongly urged the use of a thin cement joint for firebrick construction in place of the thick fire clay joint which was then the general practice.

Today the thin joint is generally recommended by firebrick masons and firebrick manufacturers as they now produce high quality brick and tile that are true to size and shape.

Select the brick best suited to your needs, bond them with HYTEMPITE and you make certain the best refractory service.

HYTEMPITE joints do not erode as there's practically no joint—just a brick to brick surface throughout the structure—*No Shrinkage —No Cracks—No Leakage.*

Thick joints of Hytempite mixed with crushed fire brick can be used when the lack of uniformity of brick makes a thick joint necessary.

Hytempite is packed in steel air-tight containers of the following weights: 800 lbs., 400 lbs., and 100 lbs.

QUIGLEY GAS-TITE BAFFLES

for boilers and stills are made of crushed old firebrick bonded with Hytempite. This mixture is either tamped in place against a lattice-work form or "shot" with the Quigley Refractory Gun. They are now installed in boilers with a total capacity of over 500,000 B.H.P.

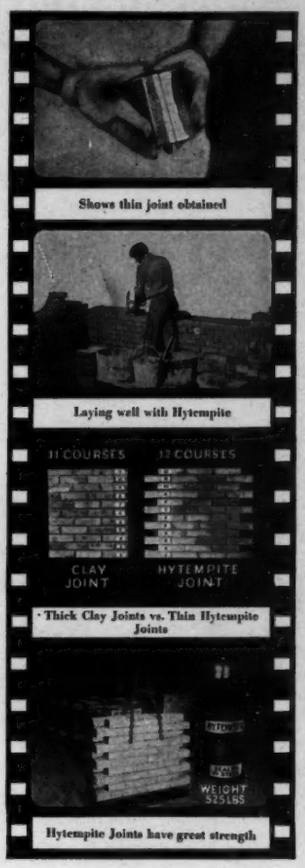
Ask for Folder BR 136.

QUIGLEY COMPANY INC.

INDUSTRIAL SPECIALTIES

56 West 45th Street, New York

Distributors with Stock and Service in every Industrial Center



CHARLITE HEAVY DUTY No. 1
for Stripping Paint

Trucks, Tanks, Drums, Tank Cars, Quickly Cleaned For Re-painting

Economical Efficient

Full Details on request

Charlite Division

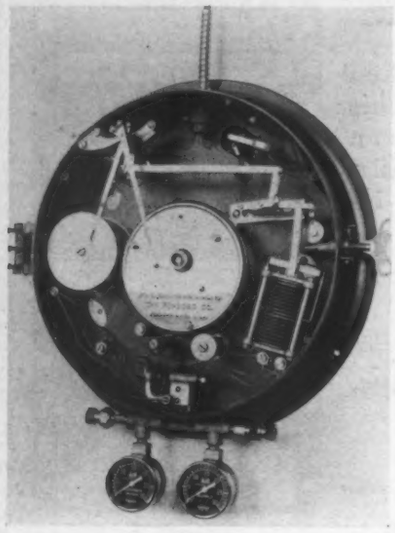
CHARLOTTE CHEMICAL LABORATORIES

CHARLOTTE, N. C. 50 EAST 42nd ST., NEW YORK

Southwestern Distributors: GENERAL SUPPLY CO., Houston, Texas

boilers and scores of other industrial processes involving temperature, pressure or flow.

It has a type of throttling range designed to prevent "hunting" or over-controlling. Its outstanding characteristics is an automatic stabilizing feature to prevent the effect of throttling range from changing the control point.



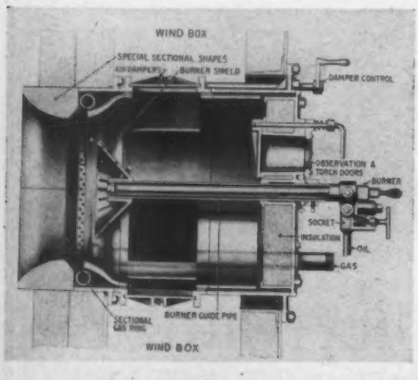
Foxboro Stabilizer

The Foxboro Company's display at the Los Angeles exposition, which will include also the dampint U-tube, new steel helical tube recording gauges, and the new refinery indicating gauge with alloy-steel parts, is in Booth 123.

Oil and Gas Burner

COEN COMPANY

Coen Company, San Francisco, has introduced the Type C oil and gas burner, a new register having a square frontal design. It has been built to meet changing conditions requiring a forced draft with pre-heated air running up to 1000°F. The design is equally suitable for either natural or induced draft, according to the manufacturers.



Coen Burner

The vanewheel, a part of most cylindrical registers, has been eliminated, air being taken through four large tangent ports, giving the same effect as a vane wheel but materially reducing air friction. All portions of the register are constructed of heat-resisting metal and are easily accessible. Design of the register is to make installation easier and more substantial, while it is possible to materially increase the frontal insulation. It may be used separately for either oil, gas or powdered fuels or in combination. The register offers a wide range of adaptability.

Recording Controllers

NEILAN COMPANY

Neilan Company, Ltd., Los Angeles, manufacturers of automatic control and regulating devices, is now marketing a line of instrument type recording controllers for temperature, pressure and flow. They are built on a new principle of the straight line function.

The manufacturers state that these controllers offer new and improved methods of easy adjustment for all types of process control. Definite increments of movement of the control element produces uniform increments of movement of the diaphragm motor valve.

Neilan Recording Controller

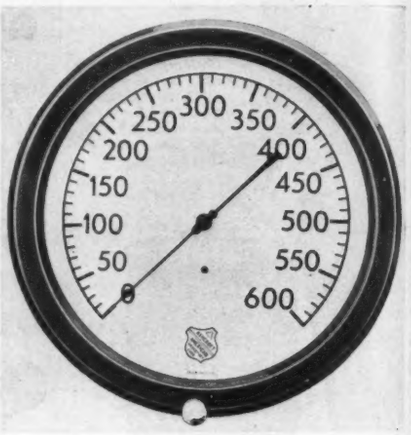
This line of Neilan instruments is on display for the first time at the Oil Engineering and Equipment Exposition in Los Angeles, March 12-22.

Pressure Gauge

CONSOLIDATED ASHCROFT HANCOCK COMPANY

Consolidated Ashcroft Hancock Company, Bridgeport, Connecticut, announces placing on the market the new Ashcroft American Duragauge to meet the growing demand for a more durable pressure gauge for high pressures and high temperatures. It is designed particularly to meet the demand on turbine work, for instance, where vibration and pulsations are prevalent under such pressures and temperatures; or in power plants where a fine gauge could be had flush mounted.

A special movement of nitralloy steel has been developed for the Duragauge



Ashcroft American Duragauge

and run on tests on sample movement for six months.

Springs bored out of special solid steel alloy were also developed so that their expansion and contraction were uniform throughout the entire range. These springs are to make possible uniform graduations on the dial and, at the same time to enable the manufacturers to make the gauge so that the accuracy would be one-half of one per cent, or more so.

The sockets are made of forged steel, and the cases are die-cast and usually furnished with black, hard rubber finish that are made absolutely water proof.

Another important feature is the unique pointer or hand which has an integral micrometer adjustment which makes it simple to compensate the gauge for water leg in the field.

Water Line Gauge

AMERICAN METER COMPANY

American Meter Company, Erie, Pennsylvania, announces an improved water line gauge and marker for wet test meters. In order to simplify the operation of correctly setting the water line all wet test meters up to and including the 100-1200 size are equipped with a new improved type of gauge glass and marker.

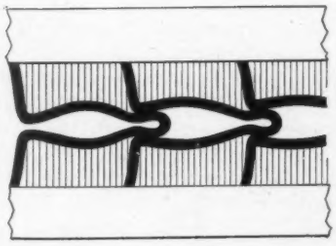
The gauge glass has an expanded portion which reduces capillary attraction by providing a large cross sectional area in the water column at the point where the meniscus forms. Instead of having two markers on the outside of the gauge glass as previously, a chromium plated pointer

"Flexitallic"
(Trade Mark)
Gaskets

RESILIENCE

What a lot of good meaning that word has for you .. with

Flexitallic Gaskets!



Right at the point where each strip of metal dovetails with another strip of metal you have a condition akin to a coiled spring. Under compression the V-shaped metal tries to assume its original, expanded position.

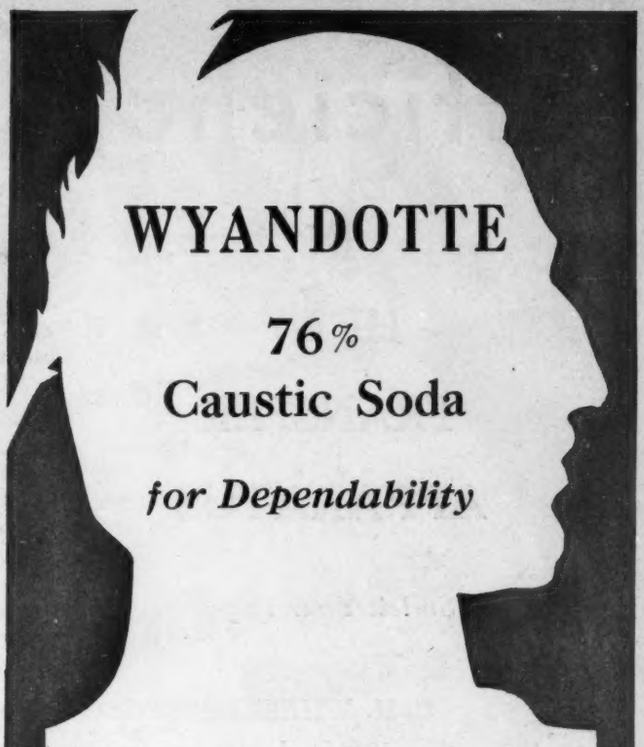
That means that with Flexitallic Gaskets, regardless of mounting pressures and heats, you have something *alive* between the parts you want to seal; something that really exerts a push of its own against the squeeze. Your seal is tight even without hard pull down!

And after release, even under the most abnormal condition, there's a come-back. You can use your Flexitallic Gasket perfectly again!

Use Flexitallic Gaskets for their resiliency; their long life; for their re-useability; their leak-proof, trouble-free service.

Steel, Monel, Copper, Aluminum, Bronze, Stainless Steel—whatever metal best fits your need. Rpresentatives in metropolitan districts. Samples and literature furnished immediately.

FLEXITALLIC GASKET COMPANY
8th and Bailey Sts. ▪ Camden, N. J.



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76% Caustic Soda

for Dependability

YOU are safe in relying on Wyandotte in every way. Should you need delivery in haste, adequate stocks near you can supply your requirements promptly.

Jobbers imbued with Michigan's ideals of comprehensive service are close by and at your command at any time.

High purity and rigid uniformity are assured by Michigan's unique ownership control of mines, refineries, factories and delivery service by rail and water. You are serving your best interests when you depend on Wyandotte 76% Caustic Soda.

Also Soda Ash, Bicarbonate of Soda and Calcium Chloride.

"Distinguished for its high test and uniform quality."

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General Sales Department
10 East 40th Street, New York City

Chicago Office: 435 N. Michigan Blvd.
Works: Wyandotte, Michigan

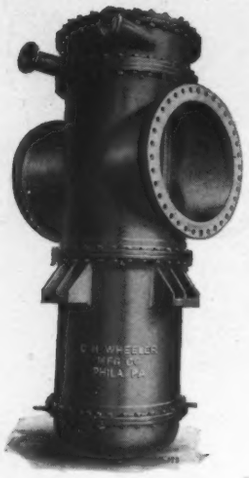
Efficiency

IN

HEAT

TRANSFER

APPARATUS



We Solicit Your Inquiries

C. H. WHEELER MFG. COMPANY
19th St., Lehigh and Sedgley Aves.
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C. H. WHEELER *of* PHILADELPHIA

Hy-Speed

EXPLOSION-PROOF

MIXERS

Hy-Speed Portable Electric Mixers are the most efficient machines manufactured for blending, compounding, mixing or agitating all oils and liquid chemicals.

They clamp to any tank or vat in one minute and produce a more thorough, rapid mix . . . . more economically than by any other process. Capacities from five to 50,000 gallons.

Write for your copy of «The Hy-Speed Age» ..... the Solution of your Mixing Problems.

For mixing

LUBRICATING OILS
LIME AND OIL
FULLER'S EARTH & OIL
ALL LIQUID CHEMICALS

ALSOP ENGINEERING COMPANY
47 West 63rd St.
New York City

is used, which is located centrally within the gauge glass and screwed into the lower support.

The threaded portion of the pointer extends through the lower support in order to allow adjustment to be made and is held in place by a lock nut after adjustment. A sealing cap is provided which screws on the lower support.

The water line may be quickly and accurately set by lowering the level of the water until the meniscus just touches the tip of the pointer. The chromium plate on the pointer permits easy visibility and offers to eliminate corrosion or discoloration.

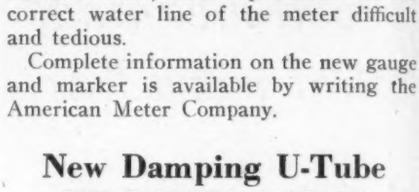
With the old type gauge glass, the water line was set by bringing the level down until the lower boundary of the meniscus in the gauge glass touched the upper plane of the markers on each side of the glass. This operation, the manufacturers state, made reproduction of the correct water line of the meter difficult and tedious.

Complete information on the new gauge and marker is available by writing the American Meter Company.

New Damping U-Tube

THE FOXBORO COMPANY

The Foxboro Company, Foxboro, Massachusetts, announces the development and placing on the market of the new damping U-tube for use on all of the company's new style flow meters and flow controllers. This U-tube may be adjusted for proper damping while the instrument is in operation. Pressure does not have to be shut off nor does the instrument have to be taken apart for adjusting.



Foxboro Damping U-Tube

A "screw-driver" is fitted to the end of the needle valve. By turning this device adjustments may be made without forcing the mercury out. Adjustments can be made very minute or very large, as conditions warrant, the manufacturers state.

The new damping U-tube is not furnished as standard equipment and must be specified on orders of a new flow meter or flow controller. It is ready for use now on all Foxboro flow meters or flow controllers in use in the field except types T, C, A and B.

New Motor Starter

LOUIS ALLIS COMPANY

Louis Allis Company, Milwaukee, Wisconsin, has recently placed on the market the first air-break "explosion-proof" motor starter developed, the company announces. This starter, known as Type E Form AAA, is built on the same principle as the Louis Allis "explosion-proof" motor.

The starter proper consists of the usual

across-the-line air-break magnetic contactor with overload and under voltage protection. Strength to withstand explosions is provided by a heavy cast iron case. The cast iron cover is held on the case by 10 heavy cap screws. Wide machined surfaces and tight joints between the case and cover offer provision for

Enclosed Starter

cooling and prevention of flame escape even if the explosive vapors enter due to "breathing" and are ignited inside the starter.

This switch is approved by the Underwriters' Laboratories, and has been placed in "Class 1, Group D," hazardous locations. It is for use in oil refineries, natural gasoline plants, chemical plants, or wherever the surrounding atmospheres may be flammable from the presence of explosive vapors or combustible dust.

The new Type E Form AAA motor starter is designed and built to eliminate the oil being used in oil-immersed starters in hazardous areas. It is further designed to prevent damage even though an explosion should occur inside the starter.

New Portable Pulverizer

DAY PULVERIZER COMPANY

Day Pulverizer Company, Knoxville, Tennessee, is now manufacturing a new model portable crusher for "Caterpillar" Twenty. These crushers are for use with "Caterpillar" tractors exclusively.

Vortex Manufacturing Company, 1978 West 77th Street, Cleveland, had issued a pocket-size folder on its paints and also announcing its method of supplying equipment for applying this paint. The equipment for utilizing the Vortex method is loaned to the purchaser of the paint for the time necessary to apply the paint. This little folder presents the reader with the story of Vortex paint and the company's method of supplying it. A copy of the folder will be furnished upon request.

Meriam Company, 1955 West 112th Street, Cleveland, has completed a 50 per cent extension to its plant. The building is the Truscon standardized type, and will house the welding department and storage. This represents the third increase in manufacturing space which this company has found necessary during the past four years.

SOLVAY*
TRADE MARK REG. U. S. PAT. OFF.
PRODUCTS

58% Soda Ash
Caustic Soda

Solid—Flake—Ground—Liquid

Leading refiners depend on these products for the quality and uniformity which industry inevitably associates with the name Solvay. First in pioneering the development of American sources of alkali, The Solvay Process Company is recognized as the outstanding leader of its field—first in size and first in facilities for rendering efficient service. Strategically located distributing points ensure prompt delivery of Solvay products with minimum transportation charges.

Write today for prices and full information.

Solvay Sales Corporation

Alkalies and Chemical Products Manufactured by The Solvay Process Company

New York

61 Broadway

*"SOLVAY" Trade Mark Reg. U. S. Pat. Off.

W. N. BEST High Pressure Oil Burner

W. N. BEST Oil Burners

are

dependable, efficient, economical, non-clogging atomizers of fuel oils, tars, acid sludges and still bottoms.

Write for catalogs.

W. N. BEST CORPORATION

Engineers and Manufacturers Since 1890

295 Fifth Avenue, New York City

ITEMS ABOUT MANUFACTURERS

American Car & Foundry Company, 30 Church Street, New York City, is mailing out a four-page folder describing the Milliken valves, used for handling gasoline, water, oil, steam, boiler blow-off, air, vacuum, gas and chemicals. These valves, which are furnished in cast iron, semi-steel, nicrofer, aluminum, bronze and other metals are briefly described in this bulletin, while full particulars are available upon application to the above address for the company's catalog on valves.

Babcock & Wilcox Tube Company, Beaver Falls, Pennsylvania, announces the publication of a 56-page catalog on Nirosta KA2 seamless tubes and pipe. Nirosta KA2 is an iron-chromium-nickel alloy steel produced under the Krupp Nirosta patents. A section is devoted to the chemical, physical and other properties of Nirosta KA2 steel, and the various analyses are given in tabular form. Throughout the booklet pictorial sections are devoted to showing the manufacture of Babcock & Wilcox Company tubing, taking the materials from the laboratory through the shops. A section is given to the subject of "Corrosion Resistance of Nirosta KA2," "Stability of Elevated Temperatures," "Design of Tubes for High Temperatures," "Temperature Limits in Pressure Service," and other subjects of equal interest. The manufacturers will furnish a copy of this booklet to interested persons upon request.

Brown Instrument Company, Wayne and Roberts Avenues, Philadelphia, is mailing out an elaborate folder in two colors presenting the new Brown electric flow meter for recording steam flow. A life-size picture of the meter is shown to illustrate how it records exactly when the steam metered was delivered. The meter shows how many pounds of steam, gallons of water, barrels of oil, cubic feet of gas or air, were delivered during any part of the day or night. Seven other features on the workings of this meter are described in the folder, which may be had for the asking.

Brown Instrument Company also has available upon request its Bulletin No. 9, "Interlocked Control in the Modern Oil Refinery," and a 32-page book devoted to covering in story and pictures the Brown electric carbon dioxide meters. Furthermore, three other books now available upon request to the company are "Power Plant Instrument Data Book," "Why You Should Use Flow Meters," and "Brown Electric Flow Meters."

Calmec Manufacturing Company, Ltd., 5817 Riverside Drive, Los Angeles, California, announces that effective January 1, it has taken over the business formerly conducted under the names of the California Manufacturing and Engineering Company and the Los Angeles Pump and Supply Company and have moved both plants together at above address. T. J. Crumpton, an oil field operator and former executive of one of the major oil companies of California, was elected president, with A. S. McIntyre as vice-president and general manager and J. J. Ferling as vice-president in charge of sales.

McIntyre, formerly president of the Los Angeles Pump and Supply Company, has been identified with the oil industry many years, including service in Mexico and South America for the larger equipment manufacturers. He was an active factor in introducing rotary drilling in California as well as in Latin America.

Ferlin, formerly president of the California Manufacturing and Engineering Company, has also been a factor in the introduction of new and improved specialties.

Cooper-Bessemer Corporation, Mt. Vernon, Ohio, has made a valuable contribution to greater power efficiency in the oil and gas industry in a 34-page handbook written by Hewitt A. Gehres, chief engineer of the company. The book explains in detail how to use and read an engine indicator on two- and four-cycle gas engines and on compressor cylinders. How to determine compression pressure; peak pressure; terminal pressure; back pressure; ignition timing; valve timing and mixture conditions and many other points of correct operation are explained in this book. A copy is offered gratis to any reader who states his title and sends the request on his company letterhead to the company at the address given here.

Electric Controller & Manufacturing Company, Cleveland, has issued a four-page folder in pictures describing the Youngstown safety limit stops for cranes, for the prevention of over-hoisting accidents. This safety limit stop, which is completely described in the folder and shown under working conditions, disconnects the motor from the power line and brings it to a quick stop, without drift. After the limit stop has been tripped, the hook block can be lowered simply by reversing the controller. The Youngstown safety limit stop resets itself automatically. Bulletin No. 1035-F describes this stop for use on alternating and direct current cranes and shows many applications illustrating how it is applied to different types of both new and old cranes. A copy is available upon request as is a copy of the above mentioned folder.

Byron Jackson Company, Berkeley, California, announces that its Eastern office is located at Bethlehem, Pennsylvania, instead of 1245 Graybar building, New York City, as heretofore. While sales offices will be maintained in New York City, correspondence for the eastern division of the company should be addressed to P. O. Box 409, Bethlehem, according to the announcement.

Lincoln Electric Company, Cleveland, has issued Section 3304, a 20-page booklet on Arc welding supplies, punched for insertion in a loose-leaf catalog. This booklet, published February 1, takes up the new "Fleetweld" process using shielded arc. The "Lightweld" electrode for light gauge steel is also taken up for complete discussion, as is the new "Kathode" welding electrode for mild steel, the "Stainweld A" electrode for 18-8 stainless steel and the "Anode" welding electrode for cast iron-machinable weld. The complete list of welding products handled by Lincoln Electric Company

-SPARKL-

SPARKL CLEANER

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WITHOUT INJURY TO ENAMEL, PORCELAIN OR LACQUER SURFACES. OTHER GRADES FOR SPECIAL USES.

BOILER SCALE SOLVENT

For taking off scale in boilers and preventing incrusting salts in the water forming new scale, to be used while operating equipment.

ENGINE SCALE SOLVENT

Formula 2 2 2

For taking off scale formed on water jackets of Internal Combustion Engines, Condensers, Heaters, Pumps, Cooling Units, etc.

Special grades for tank car cleaning and driveway cleaning.

Ward Chemical Corporation

TULSA, OKLAHOMA

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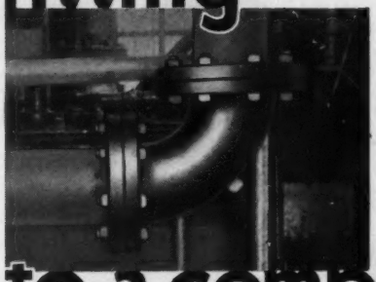
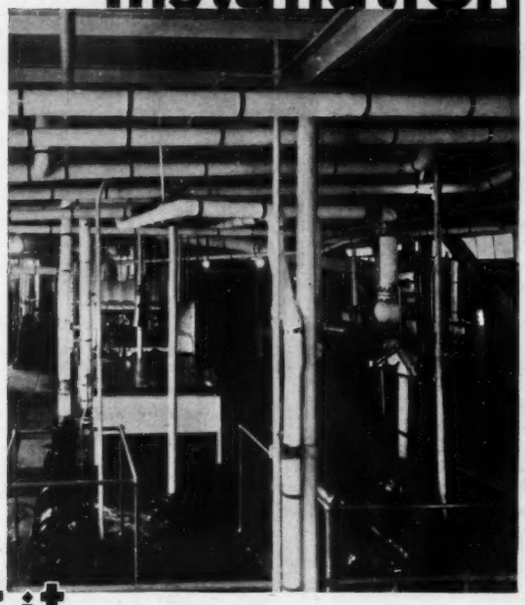
from a fitting



to a complete . . installation



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Power Piping
FOR EVERY INDUSTRIAL NEED

One order may call for a mere fitting, another for pipe bends for oil field work, still another may require high pressure piping in a process plant! In any event the experience of Power Piping Company is varied enough to meet any piping need. Design, fabrication, erection, complete supervision—any phase of piping service with economy and dispatch.

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A Real Substantial, Durable Valve for Your Various Acid Conditions

Carolina ACID VALVES

Made of Lead Alloy, Special Cast Iron and of Various Alloys to Suit Acid Conditions

1. Renewable plugs and stems.
2. Renewable seats.
3. Rising stem with very short travel.
4. Extra long stuffing box that can be packed while in operation.
5. Studs for packing gland operate from top of yoke so that they will not come in contact with acid in case of leaks around stuffing box.
6. Stuffing box can be packed while in operation.
7. Amply large hand wheel.
8. No sticking.
9. Extremely heavy construction and very durable.
10. That part of valve stem that has been in the acid does not protrude above the stuffing box.
11. Absolutely acid resisting.
12. Constructed of various alloys to suit your acid conditions.
13. Drainage gland around the stuffing box in case of leak.

Made in either straight line or angle type.

Charlotte Chemical Laboratories

CHARLOTTE, N. C.—*New York Office:* 50 E. 42 St.

Southwestern Distributors:
GENERAL SUPPLY CO., Houston, Texas

Designed by Engineers with 25 Years Experience in Acid Plants

THE CAMPBELL
Steam Flow
CONTROLLER

tells all you want to know about steam consumed by the oil still. The Controller shown here is our "Watermelon type." It does three things simultaneously: (1) Indicates pounds of steam per hour; (2) Records; and (3) Controls steam through two delivery points. Our "Pumpkinseed type" (see last month's advertisement) controls one delivery point.

CAMPBELL Controllers are being used in increasing quantity by large oil refiners all over the world. Representative list of users gladly furnished. Scientifically designed. Easily installed. Rugged. Dependable. Wherever there is a pressure drop in any process work the Campbell Controller is applicable. Send complete data and we will gladly quote.

Campbell Engineering Co.
282 SOUTH ST. NEWARK, N. J.
Manufacturers of the TAR BABY BURNER to handle Fuel Oils, Water Gas Tar, Acid Sludge and Residue Fuels.

Just Published!
"Data and Price Book"
on the
CAMPBELL Boiler Feed Water Regulator

Every refiner should have a copy of this new publication. It covers completely the subject of boiler feed water regulation and describes in minute detail the CAMPBELL regulator—the only regulator which has no moving parts—no floats—no generator—no thermostat. Easily installed by any mechanic.

ATLAS VALVE COMPANY
275 South St. Newark, N. J.

Please send me a copy of the CAMPBELL Boiler Feed Regulator "DATA and PRICE BOOK" without obligating me in any way.

Name.....
Firm.....
Street.....
City..... *State*.....

Items About Manufacturers

are shown in pictures and outlined in brief, interesting form in this bulletin. A copy is available for the asking.

General Alloys Company, 405 West First Street, Boston, announces the election of W. Kimball Leach, formerly general manager, to first vice-president. He has been with the company since January, 1923.

Hazard Wire Rope Company, Wilkes-Barre, Pennsylvania, announces "Korodless," the new chrome nickel alloy wire rope now being manufactured by the company. This new rope has been made from stainless steel to retard corrosion. The company has published a three-color folder describing and illustrating this new wire rope, and will send a copy to interested operators upon request.

Natural Gas Equipment, Inc., Petroleum Securities Building, Los Angeles, has issued catalog number 101, a 60-page book in three colors, devoted to describing and picturing Wilgus equipment, including regulators, governors, valves and control equipment. Natural Gas Equipment, Inc., maintaining offices also at 1123 Harrison Street, San Francisco; 2375 Dorr Street, Toledo; and 415 Peoria Street, Tulsa, is the exclusive distributor of Wilgus Manufacturing Company equipment. This catalog, entitled "Pioneers in Natural Gas Equipment," gives the design, construction and operation of Wilgus equipment, and aside from giving photographs of the products installed on field jobs, graphically presents hook-ups in blue print layouts. A copy of this catalog is available upon request.

National Lead Company, 111 Broadway, New York, has issued a 28-page booklet entitled "Recovery and Concentration of Sulphuric Acid," 1931 edition, which is devoted to describing and explaining the operation of the Simonson-Mantius vacuum process. This process, consisting of removing the water of dilution and concentrating the weak sulphuric acid to a desired density in a closed vessel under a relatively high vacuum by the application of indirect heat, is pictured in photographs and line drawings. The application of the process is told in simple details. The various concentrators used with the process are shown in photograph and presented also in blue print form, and described in detail. Temperature curves and tables are given, including in the latter pressures and vacuum. Engineers desiring to have a copy of the booklet will be supplied by writing the company at the address given above.

Specialists in heat and corrosion resistant alloy castings.

MICHIANA PRODUCTS CORP.
Michigan City, Ind.

Electrically Driven Centrifuges
Hand Centrifuges
WRITE
WILLIAMS, BROWN & EARLE, Inc.
Manufacturers of Laboratory Apparatus
918 Chestnut St. Philadelphia, Pa.

NEWARK

And Now—
Stainless Steel Newark Wire Cloth

Once more the Newark Wire Cloth Co. takes the lead. We developed spiral weave double surface metallic filter cloth, now used all over the world. Originated gasketed metallic filter cloth. Invented the cornerless testing sieve. Were the first to cooperate with the U. S. Bureau of Standards in the standardization of testing sieves. Are manufacturers of the finest wire cloth in the world—(400 mesh, 160,000 square openings per sq. in.) Invented a radio tube wire cloth "SEAL-EDGED" which cannot unravel.

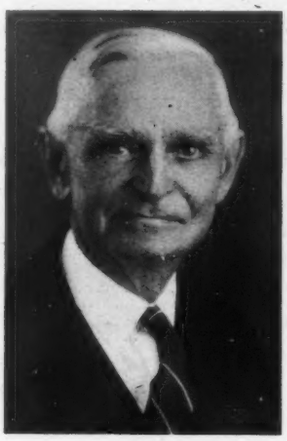
It therefore seems logical, does it not, that we should be the first to announce wire cloth made of Stainless Steel and *carried in stock?* By the time this advertisement is in print we expect to have a full stock of all standard meshes up to 120, 36" wide. Of course other meshes, weaves, and widths will be made and stocked as rapidly as possible. In fact we expect to make it as fine as our world's finest — 400 x 400 (160,000 square openings per sq. in.) as soon as demand warrants.

Our Catalog No. 26 does not mention Stainless Steel, but you can readily order wire cloth of this metal directly from the catalog with the above facts before you. Every refiner who uses wire cloth should have a copy of Catalog No. 26 at his finger's ends. It is the most complete wire cloth "treatise" obtainable.

Newark Wire Cloth Co.
364-378 Verona Ave.,
Newark, N. J.
Branch Office:
66 Hamilton St., Cambridge, Mass.

Items About Manufacturers

Roots - Connersville - Wilbraham division of Stacey Engineering Company has just issued two new bulletins, 21-B10 and 21-B11, covering the new line of Victor-Acme blowers. In combining the Victor and Acme lines, a wider range of capacities than formerly possible, is now offered. Two new types, the "AF" (anti-friction bearing) and "AFS" (anti-friction bearing and hardened steel gear) blowers have also been added and are explained in the bulletins. Descriptive bulletin 21-B10 and the price list bulletin 21-B11, replace both the bulletin 121 formerly issued on Victor blowers by Connersville Blower Company, Inc., and bulletin 21-B2 on Acme blowers by The P. H. & F. M. Roots Company.



E. P. DILLMAN

E. P. Dillman, sales manager of the Wyatt Metal & Boiler Works of Dallas, has been elected a director of the company. He has been with the Wyatt organization since 1922. Previous to this connection he was for 20 years engaged in the business of steel plate construction as a contractor.

Watson-Stillman Company, Roselle, New Jersey, has appointed The Moorlane Company of Tulsa, as exclusive representative for the sale of hydraulic machinery and accessories in Oklahoma. The Moorlane Company covers the industries of this section with a staff of field engineers.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania, has issued a 40-page publication devoted to telling of the company's engineering achievements in 1930. There is considerable information of interest to engineers contained in this pictorial booklet, and various subjects pertaining to electrical power and latest electrical equipment are covered. The company will forward a copy to interested engineers upon request.

Wickwire Spencer Sales Corporation announces the removal of its Tulsa office from the Philtower Building to 314 East Archer Street, where the company has about 10,000 square feet of warehouse space. E. L. Stevens, manager of sales, is in charge of this office.

Neilan Company, Ltd., manufacturers of automatic regulating and control equipment, announces the appointment of Arthur J. Foley as manager of the Chicago branch office, to be located at 55 East Wacker Drive.

PULMOSAN HOSE MASKS

• • • •

Pulmosan Hose Mask No. 1

Designed for use in confined quarters, such as tank cars, manholes, etc., where funnel may be extended to a source of fresh air. Outfit consists of face mask with 25-ft. non-collapsible, kink-less, 1-inch hose, with connecting pad, hook and funnel—all contained in neat, sturdy carrying case. The coupon brings detailed information and quotation.

•

Pulmosan Hose Mask No. 2

An air-supplied mask, equipped with easy-working ball bearing blower and 50 feet (or longer) of 1-inch non-collapsible, kinkless, hose; safety belt; hook and funnel. An outfit of the highest quality furnished in zinc lined carrying case. Mail the coupon for complete information.

Let PULMOSAN solve your safety problems. Write for circulars on Asbestos outfits, non-sparking tools, etc.

Pulmosan Safety Equipment Corporation

176 Johnson St., Brooklyn, N. Y.

PULMOSAN SAFETY EQUIPMENT CORP.,
176 Johnson St., Brooklyn, N. Y.
Gentlemen: Kindly send full information on your (please check)

☐ Pulmosan Hose Mask No. 1 ☐ Pulmosan Hose Mask No. 2

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Address ..... (R)

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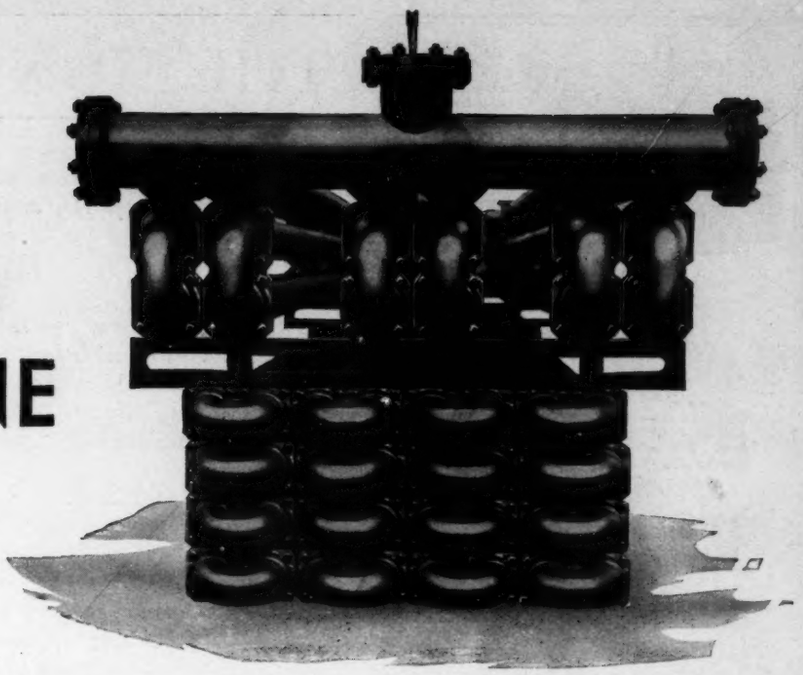
a friend named this the "SARDINE COIL"



RECENTLY, a visitor to our shops was inspecting the Simplex Square-Flanged Condenser Coil shown here. "You folks should name this the 'Sardine Coil'," he remarked. "I never saw such a compact coil!" Though made in a spirit of fun, his remarks emphasize the great improvement in coil construction made possible by our new

SIMPLEX SQUARE-FLANGED CONDENSER PIPING

This new piping provides an enormous space saving as compared with flanged pipe, round-flanged Simplex pipe, or steel pipe with standard companion flanges. Space savings as high as 50% (or even greater, depending on design of coil) can be effected with this new pipe. A greater amount of condensing area can be obtained in a box of equal size with Square-Flanged Simplex Condenser Piping than with any other type of piping or condensing material now available. Complete details are included in our new illustrated catalog "Square-Flanged Condenser Piping"—a copy of which will be mailed you free on request.

AMERICAN CAST IRON PIPE COMPANY

BIRMINGHAM, ALA.

Branches: NEW YORK CITY, CHICAGO, DETROIT, SAN FRANCISCO, MINNEAPOLIS, DALLAS, LOS ANGELES, SEATTLE, CLEVELAND, KANSAS CITY

314R

Type E Originated in 1927 by The Louis Allis Co.

The *First*
"Explosion-Proof" Fan-Cooled Motor

Type E Originated in 1930 by The Louis Allis Co.

The *First*
"Explosion-Proof" Air-Break Starter

Companion Pioneers!

Developed by Louis Allis engineers, these *companion pioneers* have brought safe individual motor drive to many hazardous industries. They have eliminated the need of fire walls, and the hazard and inconvenience associated with oil-immersed switches.

Tested and approved by Underwriters' Laboratories for Class I. Group D hazardous locations, these companion pioneers are inexpensive, simple, safe and easy to install wherever gasoline, naptha, alcohol, benzol, and equally hazardous liquids are made, used, or handled... widely used in bulk stations, terminals, refineries, natural gasoline plants, pipe line pumping stations, dry cleaning and chemical plants.

Write for complete information

WARNING: Do not confuse Louis Allis "Explosion-Proof" motors and starters with non-approved so-called "vapor-proof" apparatus. Real "Explosion-Proof" motors and starters must pass severe explosion tests to be approved by Underwriters' Laboratories for use in Class I. explosive atmospheres.

THE LOUIS ALLIS CO.
Milwaukee, Wisconsin
Offices in Principal Petroleum Centers

LOUIS ALLIS

"EXPLOSION-PROOF"
Electric MOTORS

THE MONTH IN REVIEW

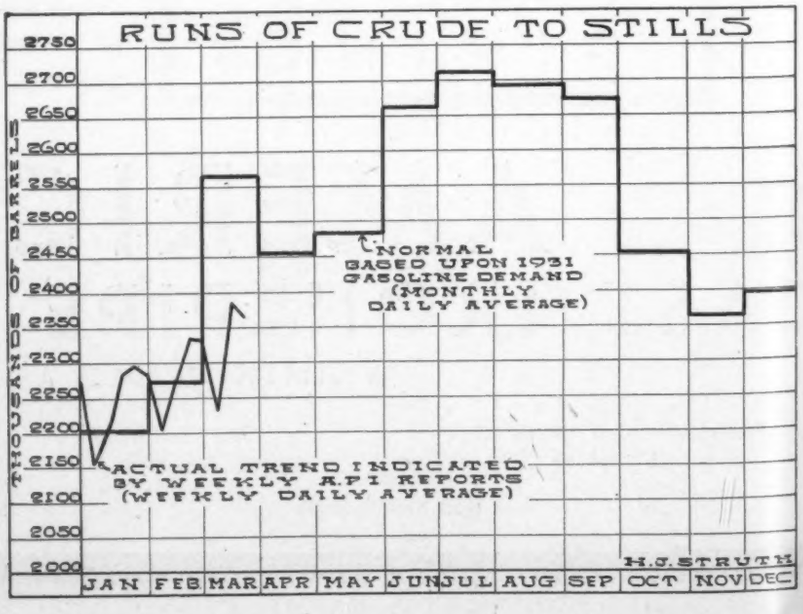
In the following columns will be found a brief digest of happenings of interest to refiners, even with reference to a rumor or two!

GASOLINE demand for the first two months of this year shows a gain over last year of 725,000 barrels in domestic consumption, although there was a decline in exports of 1,906,000 barrels. A large part of the decline in exports of gasoline was recorded in February when the total exports volume amounted to only 3,606,000 barrels, against 4,903,000 barrels in January. Domestic gasoline demand in February amounted to 26,133,000 barrels, against 26,844,000 barrels in January, a decline of 711,000 barrels. While domestic demand for both January and February was materially lower than that of last December, it is significant that the results compared with the same months of last year show a gain.

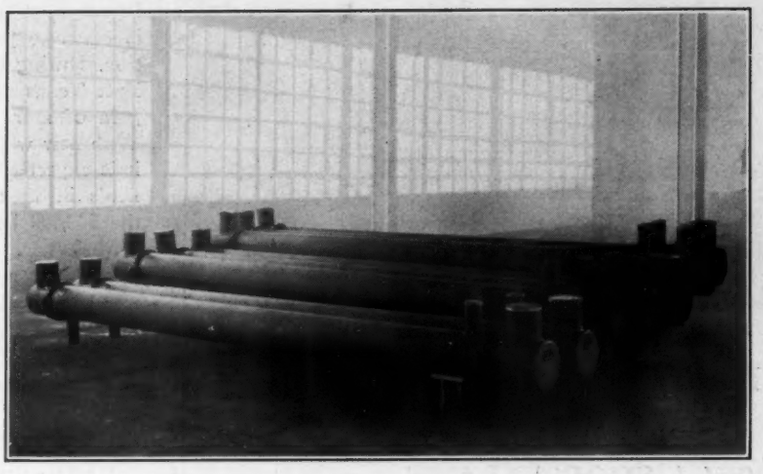
RUNS to stills of United States refineries for the month of February aggregated 65,249,000 barrels, a decrease from January of 4,777,000 barrels, according to the monthly report of the U. S. Bureau of Mines. The daily average of still runs for February amounted to 2,330,000 barrels, which was a gain over January of 71,000 barrels. The smaller total for February was due to the fact that it was a shorter month. Total runs for the first two months of this year amounted to 135,275,000 barrels, which was a decline under the same period of last year of 17,302,000 barrels.

STOCKS of crude petroleum in the United States, as of March 1, amounted to 503,980,000 barrels, a decline from the total on hand February 1, of 4,766,000 barrels. Stocks of all oils aggregated 658,285,000 barrels, as of March 1, compared with 661,757,000 barrels on February 1 and 699,377,000 barrels on March 1, 1930. California stocks of crude were only slightly lower on March 1 than on February 1, the bulk of the decline being recorded in the territory east of California.

DAILY average crude oil production in the United States is now 2,275,350 barrels, compared with the low point of 2,082,100 barrels daily established during the week ending January 3. Crude production has shown a more or less steady upward trend since the beginning of this year, partly due to increased demand by refiners and also to the bringing in of a rising tide of new production from the Rusk-Gregg area of East Texas. East Texas is now credited with a daily crude



Pipe Line Coolers



The Pipe Line Cooler, **developed by Ross, cools the Diesel jacket water by means of the crude or gasoline in the line. It replaces the cooling tower or spray pond formerly used for this purpose and has the following distinct advantages:**

1. The heat transferred to the liquid being pumped lowers its viscosity and therefore reduces the pumping head.

2. Being a closed system, no contamination of the jacket water can occur. Jacket water must be kept clean for efficient operation of the engines.

3. Evaporation losses of jacket water are eliminated. Therefore, no make-up is required.

4. Its first cost and maintenance are a small fraction of the charges against any other method of jacket water cooling.

ROSS HEATER & MFG. CO., Inc.

Main Office and Works—BUFFALO, N. Y.

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CHICAGO
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ST. LOUIS
PITTSBURGH
HOUSTON

HEAT EXCHANGERS, CONDENSERS, HEATERS, COOLERS, REBOILERS, VACUUM CONDENSERS, STEAM JET AIR PUMPS, EXPANSION JOINTS

GAS BURNERS

Heat Without Flame

Burn Rectifying Column Vapors and Still Gases

WITH A SHORT FLAME

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Over Six Thousand John Zink Burners in Use

JOHN ZINK COMPANY

Oklahoma Natural Gas Building — Phone 4-9838
TULSA, OKLAHOMA

Hy-Speed

EXPLOSION-PROOF MIXERS

Hy-Speed Portable Electric Mixers are the most efficient machines manufactured for blending, compounding, mixing or agitating all oils and liquid chemicals.

They clamp to any tank or vat in one minute and produce a more thorough, rapid mix . . . . more economically than by any other process. Capacities from five to 50,000 gallons.

Write for your copy of «The Hy-Speed Age» ..... the Solution of your Mixing Problems.

For mixing

LUBRICATING OILS
LIME AND OIL
FULLER'S EARTH & OIL
ALL LIQUID CHEMICALS

ALSOP ENGINEERING COMPANY
47 West 63rd St.
New York City

The Month in Review

production of more than 122,000 barrels, with prospects that material increases will be recorded each week until some action is taken to place that district on proration. During the week ending March 28, East Texas recorded a crude production gain of more than 30,000 barrels a day. With new wells coming in at a rapid rate it is expected that production of the new fields in East Texas will rapidly reach the 200,000 barrels mark and may reach 300,000 barrels a day before effective means are applied to arrest the rising trend of production.

CALIFORNIA crude prices were completely revised on March 30, when the Union Oil Company posted a new schedule placing high gravity crude on a flat-price basis of 35 cents a barrel and inverting the gravity scale so that differentials apply in reverse order; placing lowest gravity oil at a price of 65 cents a barrel and deducting three cents for each degree up the scale to the highest gravity which is priced at 35 cents a barrel. Cut-throat competition in the retail gasoline market in California has practically demoralized the market structure there in all of its divisions. The new price schedule undoubtedly offers an opportunity for some refiners to redouble their efforts to flood the market with cheap gasoline. In many instances, gasoline is now selling at retail in Los Angeles for eight cents a gallon, the range being from five cents to 10 cents a gallon.

FUEL oil consumption by public utility power plants in the United States for February amounted to 644,112 barrels, a decrease under January of 150,832 barrels. Compared with December, 1930, the total fuel oil consumption for February represents a decline of about 200,000 barrels. A factor in the decline, naturally, was the short month, compared with 31-day months, but it is also believed that increased use of natural gas has slowed up the demand for fuel oil from power plants in various sections of the United States. Particularly is this the case in the Pacific Coast area, where natural gas pipe lines to industrial points of consumption have made serious inroads upon the former large demand for fuel oil.

DR. WALTER H. CROSS, presi- dent of the Kansas City Testing Laboratory, and developer of one of the principle types of cracking processes, died at his home in Kansas City, March 24. Dr.

HERE'S a point which should not be overlooked when considering pipe for service of any kind where corrosion is an important factor in determining pipe life.

Everyone familiar with pipe knows that rust and corrosion usually attack first those parts of ferrous pipe which have been worked cold, such as cut ends and threads, and that the maximum resistance to attack is usually at the surface of the metal.

Such is not the case with Toncan Iron Pipe—the alloy of refined iron, copper and molybdenum. It is the only ferrous pipe possessing the same degree of resistance throughout the entire wall thickness and remaining unaffected by cold working or deformation.

Toncan Iron Pipe is the ideal pipe for all corrosion installations where the pipe must be threaded, flanged, bent, Vanstoned or otherwise worked.

Details gladly mailed on request.

REG U S PAT OFF
TONCAN
COPPER
MO·LYB·DEN·UM
IRON PIPE

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES: YOUNGSTOWN, OHIO

What Does *Good* Fence Cost?

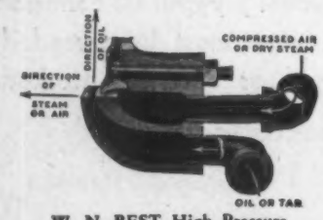
A fence whose function is to safeguard the public should be chosen with particular care. If it fails to provide adequate protection it may invite rather than discourage trespassers; or by inducing a false sense of security may become more hazardous than no fence at all.

A good fence protects against damage suits by injured trespassers, while a poor one may itself afford conclusive proof of negligence.

Continental Chain-Link Fence is structurally correct. It is erected under the supervision of experienced fence engineers. We shall be glad to advise with you without obligation. Write us today.

Continental Steel Corporation
KOKOMO, INDIANA
Distributors in all Principal Cities
Manufacturers of: Chain-Link, Farm, Poultry and Lawn Fence and Gates; Billets, Rods, Wire, Nails and Barbed Wire; Black, Galvanized and Roofing Sheets (155)

CONTINENTAL
TRADE MARK



W. N. BEST High Pressure Oil Burner

W. N. BEST Oil Burners
are
dependable, efficient, economical, non-clogging atomizers of fuel oils, tars, acid sludges and still bottoms.

Write for catalogs.

W. N. BEST CORPORATION
Engineers and Manufacturers Since 1890
295 Fifth Avenue, New York City

The Month in Review

Cross was 53 years old and had been ill since December.

Dr. Cross was a graduate of the University of Missouri where he received his degree as a doctor of medicine. With his brother, Doctor Roy Cross, he developed the Cross cracking process and conducted the Kansas City Testing Laboratories, one of the largest and most widely known institutions of its kind. He was one of the owners of Gasoline Products Company, holders of the Cross patents on cracking and other refining processes.

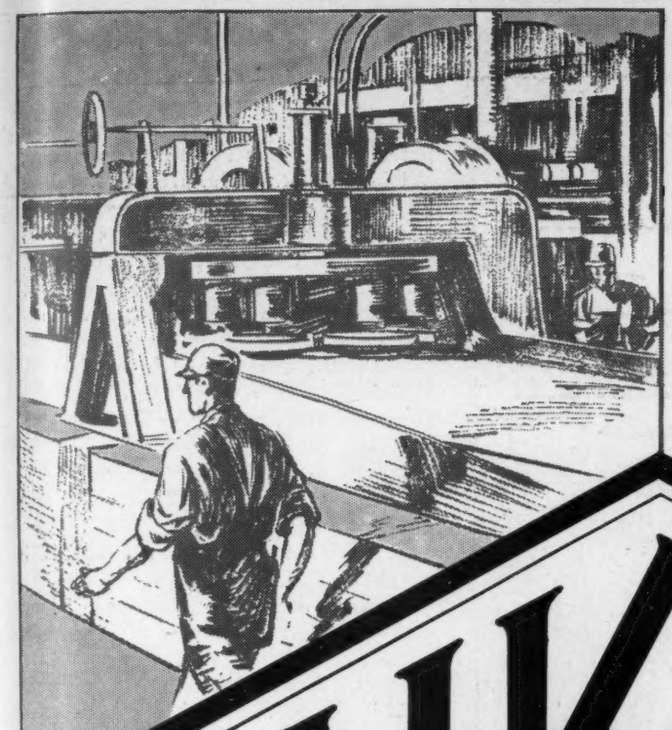
The first commercial installation of the process perfected by Dr. Cross was installed at the plant of Indian Refining Company (now controlled by The Texas Company), in 1921. This first unit was designed to process 700 barrels per day of fuel oil or gas oil and to yield 30 to 35 per cent gasoline.

AUTHORIZATION *has been* issued by the provisional government to a Buenos Aires firm to construct and exploit a petroleum refinery in that city, according to advices received in the Department of Commerce from Assistant Trade Commissioner Charles H. Ducote, Buenos Aires.

The refinery is to have a daily handling capacity of 10,000 barrels; products will be mainly gasoline, kerosene and fuel oil. At the beginning it is expected to import all the petroleum required. The name of the erecting company was not reported.

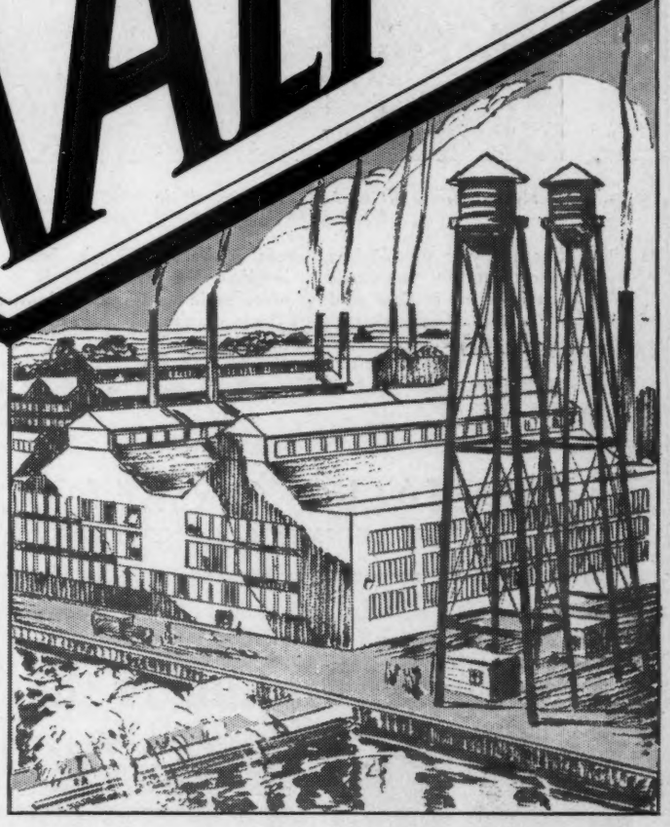
THREE *men, who had not previ*ously served on the board of directors of the Western Petroleum Refiners Association, were among those elected at the annual meeting of the organization in Excelsior Springs, Missouri, March 10, 11 and 12, 1931. They are U. deB. Daly, president, Shell Petroleum Corporation, St. Louis; R. W. McDowell, vice president, Mid-Continent Petroleum Corporation, Tulsa; and H. J. Scott, vice president of Marathon Oil Company, Tulsa.

Directors re-elected are: H. T. Ashton, president, Lubrite Refining Corporation, St. Louis; C. M. Boggs, president, Kanotex Refining Company, Arkansas City; Sheldon Clark, vice president, Sinclair Refining Company, Chicago; A. L. Derby, president, Derby Oil Company, Wichita; T. T. Eason, president, Eason Oil Company, Enid; John L. Gray, vice president, Deep Rock Oil Company, Tulsa; D. P. Hamilton, president, Root Refineries, Inc.,



We are PROUD *of this* MARK

ALKALI



MANY years of unremitting manufacturing vigilance have built up the national reputation and acceptance which Diamond Brand Alkalies enjoy today. Particularly in the petroleum industry the Diamond trademark has become symbolic of quality among users of 76% Caustic Soda everywhere.

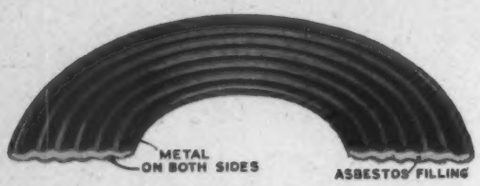
Naturally we are ever zealous in maintaining this high regard—a confidence which we consider priceless and which daily finds expression in the very highest quality Caustic Soda that a great, modern plant can produce.

[*When purchasing Caustic Soda specify* 76% actual test—*there is a difference.*]

DIAMOND ALKALI COMPANY

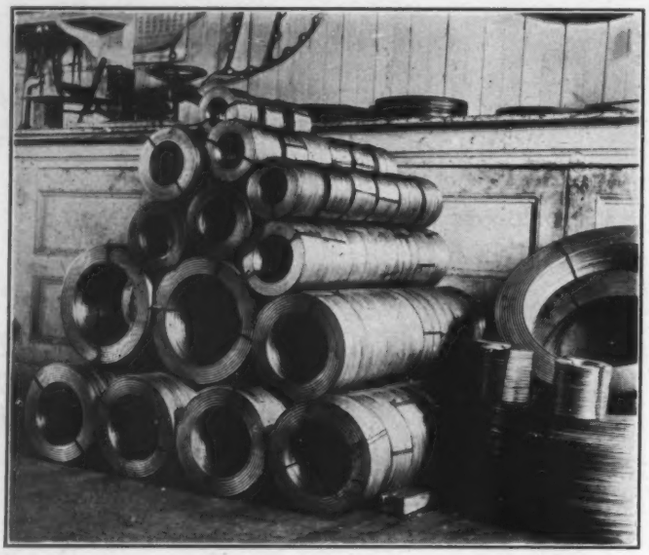
PITTSBURGH . . . . . PENNA.

Southwest Representative: FRED W. FRALEY, Jr., 1006 Main St., Houston, Texas



METALLO
STYLE 1000 » »

REFINERY TYPE
METAL-ASBESTOS
GASKETS



Recent shipment of 3,180 Metallo Style 1000 Refinery Type Gaskets for Series 30 flanges

Whether you use Dubbs, Cross, Tube and Tank, Jenkins or Lewis Cracking Process, you can rely implicity on Metallo Refinery Style 1000 Gaskets for all tongue and groove, male and female joints, and extra heavy flanges. Constructed with double jacket of corrugated Armco Iron, Steel, Monel Metal, Aluminum, Copper or Chromium Alloys, with filling of Asbestos, it is particularly adapted for any joints on cracking stills where pressures are up to 2,000 pounds, and temperatures up to 2,000 degrees Fahrenheit.

Write for Prices.

METALLO GASKET CO.
NEW BRUNSWICK — NEW JERSEY

The Spiral Motion Is the Trick

That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request

B. MIFFLIN HOOD CO., DAISY, TENN.

The Month in Review

Shreveport; C. L. Henderson, vice president, Vickers Petroleum Company, Wichita; R. R. Irwin, president, White Eagle Oil Corporation, Kansas City; E. J. Marston, president, Texas Pacific Coal & Oil Company, Fort Worth; T. M. Martin, vice president, Lion Oil Refining Company, El Dorado, Arkansas; E. S. Karstedt, vice president, Continental Oil Company, Ponca City; F. R. Schneider, vice president, Simms Oil Company, Dallas; H. A. Trower, vice president, Phillips Petroleum Company, Bartlesville; P. J. Gwynn, vice president, Iowa Park Refining Company, Wichita Falls; and L. H. Prichard, president, Anderson-Prichard Oil Corporation, Oklahoma City.

Former presidents of the association, who are thereby members of the board of directors, are Roy B. Jones, president, Panhandle Refining Company, Wichita Falls; P. M. Miskell, general manager, Empire Oil & Refining Company, Tulsa; D. W. Moffitt, director, Mid-Continent Petroleum Corporation, Tulsa; and George Moore, receiver for Cosden Oil Company, Fort Worth.

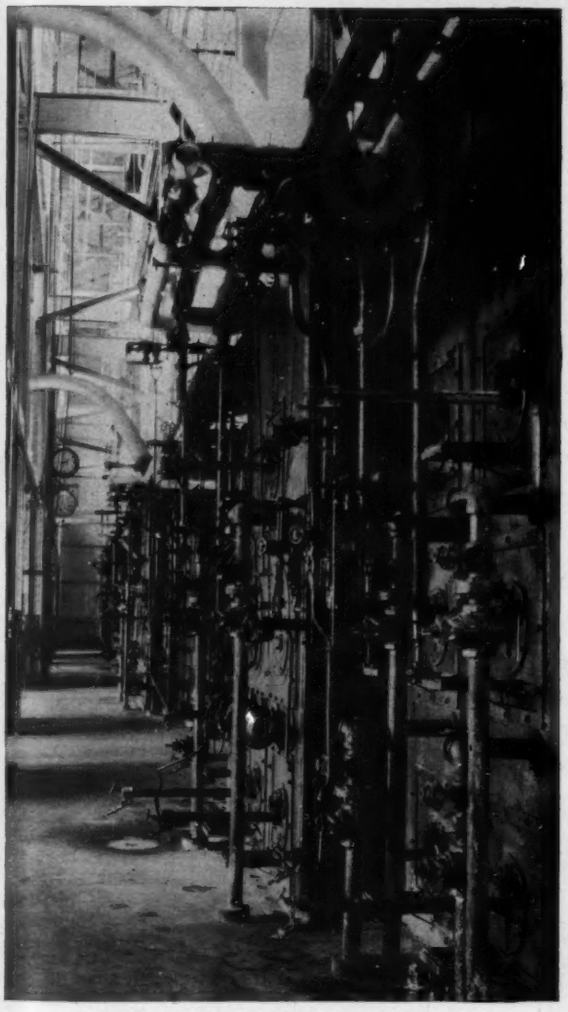
A REFINERY for some western Nebraska town, preferably Crawford, is in contemplation by Osage Trust Company, one of the principal operators in the Osage field, Weston County, eastern Wyoming. Osage Trust Company has a potential production of 1000 barrels per day of high grade crude.

DEPOSITARIES of Cities Service Company in California have received notice from the company not to accept any more Richfield Oil Company of California preferred stock for exchange, and the exchange offer has been withdrawn. The notice did not state whether Cities Service has already received the desired 100,000 shares of this stock recently stipulated in the published offer to exchange. The exchange offer on the common stock was withdrawn some time ago. It is commonly thought that Cities Service Company has secured control of Richfield Oil Company of California. Executive representatives of the Doherty company have been inspecting Richfield properties during the past few weeks but have declined to make any public statement.

BECAUSE of lack of crude market the Ring brothers and their associates plan to refine their own crude and such

BURNERS

PEABODY



View of Boiler Fronts, Showing Peabody Burners

Acid sludge, neutralized sludge, wax tailings, soda bottoms and pulverized refinery coke are burned either alone or in combination with fuel oil or natural gas under these four boilers, each boiler being equipped to burn four fuels at one time.

Mechanical Atomization of Waste Fuels by Peabody Burners

Feature Installation in Louisiana Steam Products Plant

The following excerpt from an article in *Power*, January 13, 1931, written by Mr. James F. Muir, Mechanical Engineer, Stone & Webster Engineering Corp., designers and builders of the Louisiana Station of Louisiana Steam Products, Inc.:

"Efficient utilization of miscellaneous oil refinery sludges at this station represents one of the most important developments of the past year in fuel-burning systems. Stone & Webster Engineering Corporation, in co-operation with the Peabody Engineering Corporation, successfully introduced for the first time the mechanical atomization of refinery waste sludges. The economic gain has been at least threefold. Avoidance of steam atomization has not only made possible improved combustion efficiency and prevented a steam loss amounting to several per cent of the total generation, accompanying this method of atomization, but has also made possible a lower moisture content of the flue gases and consequent lowering of the dew point and permitting the attainment of a lower exit gas temperature in the heat-absorption apparatus without risk of corrosion from the acids these gases contain."

PEABODY
ENGINEERING CORPORATION

46 East 41st Street, New York, N. Y.

BIRMINGHAM
BOSTON
CHICAGO
CLEVELAND
DENVER
DETROIT
HOUSTON
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LOS ANGELES
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EJECTOR TYPE AIR PUMPS

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Consult us on your problems.

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Pulmosan Hose Masks

Pulmosan Hose Mask No. 1

Designed for use in confined quarters, such as tank cars, manholes, etc., where funnel may be extended to a source of fresh air. Outfit consists of face mask with 25-ft. non-collapsible, kink-less, 1-inch hose, with connecting pad, hook and funnel—all contained in neat, sturdy carrying case. The coupon brings detailed information and prices on this, and other types.

Let PULMOSAN solve your safety problems. Write for circulars on Asbestos outfits, non-sparking tools, etc.

PULMOSAN SAFETY EQUIPMENT CORP.,
176 Johnson St., Brooklyn, N. Y.

Gentlemen: Kindly send full information on your (please check)

☐ Pulmosan Hose Masks ☐ Pulmosan Respirators
☐ Non-sparking Tools ☐ Asbestos Outfits

Name .....

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The Month in Review

other oil as they can buy, in a new refinery to be erected at Bandini, California. The new plant will operate as Ring Refining Company, and capacity rating is reported at 4500 barrels per day. Reports also state that the new company's fuel oil to the amount of 2000 barrels per day has been sold under contract.

W. T. ATKINS has been elected vice president and a director of Skelly Oil Company. He is also a member of the executive committee, along with W. G. Skelly, president, C. C. Herndon and H. M. Stalcup.

The vacancy in the Skelly official list and directorate came about through the death of F. A. Pielsticker, vice president in charge of refining, early this year.

W. T. ATKINS
Made vice-president of Skelly Oil Company

In January of this year Mr. Atkins was named general sales manager, when the entire sales department of the company was combined and moved to Kansas City. Previous to this he had been in charge of retail sales. Mr. Atkins will continue to make his headquarters in Kansas City, Missouri.

STANDARD Oil Company (Indiana) has just announced the addition to its line of Iso-Vis motor oils, an extra heavy grade. The base has an S. A. E. No. 70 viscosity. The heaviest oil previously marketed was a special heavy S. A. E. No. 60 viscosity. The new oil is to be recommended by the company for use where especially heavy oil is required in gasoline burning crankcase lubricated engines.

"EASY TO HANDLE"

PIONEER OYSTER-SHELL QUICKLIME, whether received in bulk or in the solid steel drum illustrated above, is quickly and economically handled by belt, screw or pneumatic conveyors. There is **no core** to be removed, and **no crushing** is required.

PIONEER OYSTER-SHELL CHEMICAL HYDRATED LIME---shipped in three-ply bags---is unloaded, stored and distributed without trouble and with a minimum of effort. **It will not clog dry-feed machines.**

THE HADEN LIME COMPANY
MFRS. OF PIONEER OYSTER SHELL LIME
1720 SHEPHERD STREET
HOUSTON-TEXAS

Thoroughly Qualified for Gasoline Plants

IN gasoline manufacture, this *C-F* Back Pressure Regulator has made a reputation for proficiency in satisfying back pressure requirements. It will hold back any pressure from 300 to 800 pounds. At the same time it will either *continuously* or *intermittently* (depending upon which of two types is used) discharge the gas.

It can be used in the supply line to a distributing system having approximately atmospheric pressure or it can be used against a back pressure which is only slightly lower than the pressure to be controlled. In either of these cases the discharge is usually *continuous.*

It can be used also where auxiliary pressure for the operation of the regulator is desired. In this case, the *intermittent* type is employed.

Let us send the bulletin which describes and illustrates the operation and construction features. There is sure to come a time when (and there are many places in your plant where) this fine *C-F* Regulator can be called into your service.

C-F Back Pressure Regulator

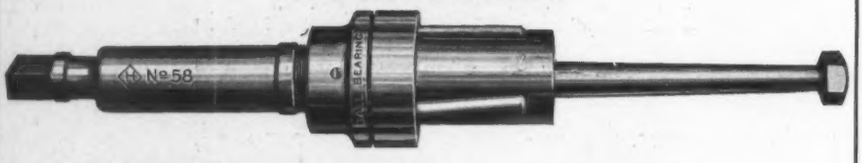
(Pilot Valve type for High Inlet Pressure)

THE CHAPLIN-FULTON MANUFACTURING CO.

Organized 1884—Oldest Builders of Gas Regulators in the Country. Built in all Sizes, from 1 inch to 24 inches; for all Service. 1 oz. up to 2,000 lbs., Pressure to Square Inch.

28-40 PENN AVENUE PITTSBURGH, PA.

Heavy Duty Expanders for Still Tubes



Tools for the Oil Industries

Hydraulic Pressure Pumps, 8000 pounds
Tube Expanders for Cracking Still Tubes
Hydraulic Pressure Pumps, 2000 pounds
Tube Expanders for Condenser Tubes
Hydraulic Pressure Pumps, 500 pounds
Tube Expanders for Steam Boilers
Screw Punches for Structural Shapes
Tube Expanders for Pipe Work
Screw Punches for Plate Work
Flaring Tools for Still Tubes
Beading Tools for Still Tubes
Hydraulic Jacks
Hydraulic Punches

A. L. HENDERER'S SONS

Wilmington, Del.
Established 1870
Expanders since 1884

The Month in Review

THE Twenty-Second Semi-annual Motor Gasoline Survey, Report of Investigations No. 3092, by A. J. Kraemer and E. C. Lane, Bureau of Mines, is now ready for distribution. This gasoline survey was made on a basis of 298 samples; 194 being "competitive priced gasolines" and 104 samples of "premium priced motor fuels." The samples were gathered in 20 areas scattered throughout the United States.

Data on the individual samples are reported for gravity, Reid vapor pressure, distillation range, color, doctor test, copper-strip corrosion, sulphur content, and "gum" content by the "copper dish test" and the steam-oven test developed by the Bureau of Mines. The service station price and the tax have also been recorded for each sample. The data on individual samples have been analyzed by means of tables showing the classification of samples according to the results of various determinations, e.g., sulphur content, and by other tabulations in which samples have been classified according to various properties, e.g., color, to indicate the relationship or lack of relationship of those properties to other properties of the fuels.

In reporting anti-knock qualities the octane number is used. The average octane number of the premium gasoline is 74 and the range is from 65 to 80. The average octane number of the competitive gasolines is 59 and the range is from 51 to 68.

ALEMITE Corporation is now offering Alemite motor oil a 100 per cent pure Pennsylvania oil refined under the new Alemite process designed to eliminate all solids and non-lubricating elements, leaving a thoroughly balanced structure.

THROUGH purchase of Long Oil Company, Manhattan, Kansas, and Keeton Oil Company, Kansas and Oklahoma, Prairie Oil & Gas Company has entered the marketing branch of the oil industry. Purchase of the two companies gives Prairie Oil & Gas Company 23 bulk plants and 56 service stations, and about 60 dealer accounts.

Long Oil Company, acquired through purchase of stock control, operated 12 bulk plants and 40 service stations, and serviced about 30 dealer accounts. Keeton Oil Company operated 11 bulk plants and 16 service stations, and serviced about 30 dealer accounts.